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NUCLEAR SCIENCE ABSTRACTS

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Volume 12 Number 13
Abstracts 8236-8909

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Technical Information Service Extension, Oak Ridge, Tennessee

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NUCLEAR SCIENCE ABSTRACTS

A Publication of the United States Atomic Energy Commission Technical Information Service.

SCOPE

Nuclear Science Abstracts (NSA) is intended to serve scientists and engineers working in the field of atomic energy by abstracting as completely and as promptly as possible the literature of nuclear science and engineering. It covers not only unclassified and declassified research reports of the U. S. Atomic Energy Commission and its contractors, but also material that appears in research reports of other U. S. and foreign government agencies, universities, and industrial research organizations and in the technical and scientific journals.

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Each issue of *NSA* is indexed by personal author and by report number. Semiannual and annual index issues are prepared for each volume and include subject, corporate and personal author, and report number indexes, listing the availability of all USAEC reports abstracted. A cumulated report number, author, and subject index to Vols. 1 through 4 was issued as Vol. 4, No. 24B, Dec. 30, 1950.

AVAILABILITY

NSA is issued twice a month and is available in single copies (priced according to the number of pages they contain, plus postage on foreign orders) or by subscription ($12.00 a year domestic, $15.00 a year foreign) from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

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The lists of New Nuclear Data are compiled by the Nuclear Data Group of the National Research Council, Washington 25, D. C. The same information is also supplied by that group on 3 × 5 inch cards for $15.00 a year in the United States and Canada (1st class postage) and for $15.00 (printed matter postage) or $19.00 (1st class postage) elsewhere.

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USAEC reports also may be consulted at the AEC depository libraries listed on the inside front cover. Collections of AEC reports outside the United States have been established and are being maintained at those addresses listed on the inside back cover.

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The printing of this publication has been approved by the Director of the Bureau of the Budget, July 30, 1957.

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ERRATA

NSA Vol. 12, No. 3, p. 263. In abstract 2285, WAPD-TM-36 should be WAPD-TM-36(EXTRACT).

NSA Vol. 12, No. 8, p. 637. In abstract 5626, A. Teste du Baillet should be A. Teste du Bailler.

NSA Vol. 12, No. 8, p. 601. In abstract 5312, J. Am. Chem. Soc. should be J. Am. Ceram. Soc.

NUCLEAR SCIENCE ABSTRACTS

Volume 12 Number 13 July 15, 1958

GENERAL

8236 TID-4550(4th. Rev.)
Technical Information Service Extension, AEC.
WHAT'S AVAILABLE IN THE UNCLASSIFIED ATOMIC ENERGY LITERATURE. Jan. 1958. 63p.
Available free of charge (TISE).

This publication explains what unclassified atomic energy research information is available, how to locate and use this information, and how this information may be obtained. Assistance in locating, obtaining, and using fully the information announced in abstract journals, indexes, bibliographies, and other informational guides issued by the U. S. Atomic Energy Commission is given. The report codes used by the Atomic Energy Commission and its contractors are explained, and their uses in bibliographic control of information are discussed. The major sources of information developed in the national nuclear energy program are listed. Complete instructions are given on how to obtain unclassified materials through the Atomic Energy Commission depository libraries and the Office of Technical Services. A list of pamphlets covering questions concerning licenses, contracts, government regulations, and other administrative matters pertinent to the Civilian Application Program is given. (auth)

8237 TID-5001(2nd Rev.)
Technical Information Service Extension, AEC.
SUBJECT HEADINGS USED IN THE CATALOGS OF THE UNITED STATES ATOMIC ENERGY COMMISSION. Second Revised Edition. Charles W. Hargrave, ed. Apr. 1958. (Bk. 1, 434p. and Bk. 2, (Appendixes), 155p.) $7.00(OTS).

8238
PROCEEDINGS OF THE HEALTH PHYSICS SOCIETY. FIRST ANNUAL MEETING, JUNE 25-27, 1957. Ann Arbor, University of Michigan, [1958]. 253p. $3.00.

Papers and abstracts presented at the first annual meeting of the Health Physics Society at the University of Michigan from June 25 to June 27, 1957, are compiled. (J.S.R.)

Atomic Bombs and Warfare

Refer also to abstract 8252.

8239 R-309(RAND)
RAND Corp., Santa Monica, Calif.
CLOSE-IN FALLOUT. Sept. 30, 1957. 43p.

A summary is presented of the physical processes of radioactive fallout from nuclear weapons and of methods of computing fallout patterns. The emphasis is on close-in fallout, or fallout occurring within a few hundred miles of the weapon burst point. (auth)

Atomic Power

8240 IGRL-IB/R-6(2nd Ed.)
United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England.
NUCLEAR POWER AND REACTOR ENGINEERING: SELECTED AND ANNOTATED REFERENCES. J. C. Hartas. Feb. 1958. 17p. $0.54(BIS).

Lists of publications in English readily available commercially or through public and other large libraries, together with a selection of forthcoming works, are given. Some background reading is indicated, e.g., on reactor materials, safety, economics etc., but books dealing specifically with nuclear physics are omitted. Generally, references to the large volume of report literature issued by atomic energy establishments, or to particular papers in periodicals are omitted, though some UKAEA bibliographies, some reprints, and one special issue of a journal are included for their special usefulness. A select list of journal titles in this field is appended. (auth)

8241 KAPL-1804
Knolls Atomic Power Lab., Schenectady, N. Y.
HEALTH PROBLEMS ASSOCIATED WITH THE CIVILIAN REACTOR PROGRAM. J. J. Fitzgerald and J. L. Flynn. Apr. 30, 1957. 35p. Contract W-31-109-Eng-52. $1.00 (OTS).

The radiation protection records achieved in the operation of AEC-owned reactors and nuclear facilities clearly demonstrate that the nuclear industry is one of the safest industries in which one may work. There is no reason to believe that there will be any unsolvable health problems associated with the civilian power reactor program. The increased levels of operation will be offset by the industrial utilization of the unique radiation protection techniques, procedures, and standards that were developed and perfected under the sponsorship of the AEC. (auth)

8242
POLAND'S NUCLEAR ENERGY PLAN. P. J. Nowacki. Nukleonika 3, 3-13(1958). (In Polish)

The electrical power requirements and the coal and brown coal production in Poland are discussed. The coal production surplus is expected to be rapidly diminishing; while in 1955 the surplus reached 23.8 million tons, it is estimated that by 1980 a deficit of 5.3 million tons should be expected. The necessity for an early start in construction of nuclear power plants is stressed. The first nuclear power plant of 200 Mw is planned to be in operation by 1965 and by 1980 the increasing power demands should be supplied by nuclear power stations. The performance and costs of electricity from the first nuclear power station and the conservation of coal are estimated. (R.V.J.)

Research Programs

8243 UCRL-8201
California. Univ., Berkeley. Radiation Lab.
A SUMMARY OF THE BERKELEY CONFERENCE ON BIOLOGICAL EFFECTS OF COSMIC RAYS AND ACCELERATED HEAVY IONS. Cornelius A. Tobias, Howard C. Mel, and David G. Simons. Mar. 10, 1958. 14p. Contract W-7405-eng-48. $0.50(OTS).

An informal conference was arranged for January 21 and 22, 1958, to discuss the present status of knowledge of biological hazards of primary cosmic rays in space flying and to plan avenues of research that should lead to more definite knowledge. A program of the meeting and a summary of the recommendations resulting therefrom are presented. (C.H.)

BIOLOGY AND MEDICINE

8244
VETERINARIAN HEALTH PHYSICS. F. J. Bradley and L. Johnson (Ohio State Univ., Columbus). Proc. Health Phys. Soc. 67-70(1957).

The use of irradiation units and radioisotopes in the field of veterinary medicine is discussed. (J.S.R.)

8245
A DEFINITION OF "SIGNIFICANT AMOUNT" TO BE APPLIED TO RADIOISOTOPE WORK. R. J. Magill (Univ. of California, Berkeley). Proc. Health Phys. Soc. 192-4(1957).

Although most legislative acts and authoritative sources of information concerning safe practices in working with radioactive materials suggest certain health protective measures for persons working with a "significant amount" of radioactivity, the amount considered significant is usually left undefined. It is suggested that the meaning for the term "significant amount" be that amount of material which in the case of a total accident would involve as much irradiation to a critical organ over a finite period of time, say one month, as a permissible body burden. (J.S.R.)

8246
FIELD RADIATION MONITORING RELATIVE TO EXPERIMENTAL REACTORS. P. Griffiths and E. D. Graham, Jr. (U. S. Atomic Energy Commission, Idaho Falls, Idaho). Proc. Health Phys. Soc. 195-7(1957).

The fixed and mobile monitoring units used by the A.E.C. Health and Safety Division at the National Reactor Testing Station are briefly described. Because of the variety of experiments performed, the Division has placed the emphasis upon mobility of monitoring equipment and a positive communication system. (J.S.R.)

8247
LOADING AND HANDLING RADIOACTIVE TARGETS FOR ACCELERATOR BOMBARDMENT. M. D. Thaxter (Univ. of California, Berkeley). Proc. Health Phys. Soc. 227-30 (1957).

The difficulties and problems encountered in the loading and handling of radioactive targets at the Radiation Laboratory in Berkeley are described for each of the five accelerators now existing and for the one now under construction. (J.S.R.)

Radiation Effects

8248 AF-SAM-57-151
Texas. Univ., Austin and School of Aviation Medicine, Randolph AFB, Tex.
LONG-TERM EFFECT OF RADIATION ON CREATINE METABOLISM IN THE RAT. George M. Krise, Clyde M. Williams, and Donald R. Anderson. June 27, 1957. 5p.

The urinary output of creatine and creatinine was measured intermittently for 6 months in 3 female Sprague-Dawley rats surviving 435 rep of mixed radiation (neutron: gamma ratio of 3 : 1) and in 3 animals surviving 1,500 rep of Co^{60} gamma radiation. No changes in output of creatine and creatinine were observed in the former group once the initial (5-day) postradiation interval was over. In the case of the animals surviving 1,500 rep of Co^{60} gamma radiation, creatinine output was significantly depressed following radiation, and creatine output was significantly elevated during both intervals examined for the first 2 months postradiation. It was tentatively concluded that radiation does not have any immediate effect on creatine synthesis at doses up to 1,500 rep and that 1,500 rep of gamma radiation may permanently destroy tissue containing creatine. (auth)

8249 COO-215
Utah Univ., Salt Lake City. Radiobiology Lab.
ANNUAL PROGRESS REPORT. C. N. Stover, Jr., ed. Mar. 31, 1958. 192p. Contract AT(11-1)-119. $28.80 (ph OTS); $8.40(mf OTS).

Progress is reported in studies on the long-term toxic effects of radioactive heavy metals in dogs. Data are included on the pathological effects and clinical symptoms in dogs receiving Pu^{239}, Ra^{226}, Ra^{228}, and Sr^{90}. Photographs of contact autoradiograms of bone from autopsied dogs illustrate bone deposition patterns. Histopathologic findings are described. A method is described for the standardization of strontium-90 injection solutions, and a procedure is described for determining the retention of strontium-90 in dogs by bremsstrahlung counting. Whole-body gamma measurements were made on 38 persons to determine the natural potassium-40 and the cesium-137 content in humans in the Salt Lake City area. A positioning method is illustrated for whole-body low-level counting of humans with a liquid scintillation detector. An attempt was made to correlate cesium-137 content with milk consumption in humans. Data are included from a study of changes in the mechanical strength of bone due to internally deposited radioelements. A list is included of publications by staff members during the period. (For preceding period see AECU-3583.) (C.H.)

8250 NYO-3320(Pt. II)
Columbia Univ., New York.
TERMINATION REPORT—PART II. FOOD IRRADIATION AND ASSOCIATED STUDIES. Apr. 15, 1956. 77p. Contract AT(30-1)-1186. (CU-3-56-AEC-1186-Chem.) $0.45 (OTS).

Results are summarized from the following studies: factors affecting the mean lethal dose of radiation required to kill microörganisms; a survey of current theories on the biological action of radiation; the protective effects of both organic and inorganic chemicals for microörganisms from the lethal effects of radiation; radiation dosage calculations for sterilization of food and pharmaceuticals; the development of a cellophane-dye dosimeter for the 10^5 to 10^7 roentgen range; and the radiation induced degradation of dextran in solution. A list of publications during the period is included. (For preceding period see NYO-3320.) (C.H.)

8251 ORO-169
Tennessee. Univ., Knoxville.
AGRICULTURAL RESEARCH PROGRAM. Semi-Annual Progress Report for January 1, 1957 to June 30, 1957. 54p. Contract AT-40-1-GEN-242. $1.50(OTS).

Seventy-eight samples were irradiated at the plant and seed irradiation facility, including 67 seed samples; bud-

wood of peach, chestnut, and grape; johnsongrass rhizomes; and sweetpotato roots. Pre-packaged irradiated barley seed and a mimeographed information letter, were prepared for distribution to high school science classes. The program is included for a symposium on Radiation in Plant Breeding held at Oak Ridge in January, 1958. Data are included from the following studies: factors controlling the metabolism of cesium and strontium in both plants and animals; the metabolism of calcium and strontium in rats; factors affecting the metabolism of calcium and phosphorus in lambs; radiation effects on reproductive physiology in cattle and rats; the relationship of survival time and whole-body gamma radiation dosage in swine, burros, and cattle; and a comparison of radium and strontium-90 toxicity in sheep. A list of publications during the period is included. (For preceding period see ORO-163.) (C.H.)

8252 TOI-W-56-2

Technical Operations, Inc., Arlington, Mass.

THE DISTRIBUTION OF THERMAL INEFFECTIVES. R. A. Langevin, R. Greenstone, and C. O. Elder. May 1, 1957. 83p. Contract DA-29-044-XZ-467. (AFSWP-1041).

A calculation was made of the fraction of military personnel exposed to thermal radiation from a nuclear weapon receiving first, second, and third degree burns. Different curves were drawn depending on the type of evasion tactic assumed, the yield of the weapon, and the total energy in the thermal pulse. An estimate was also made of the military effectiveness of the exposed troops. Factors considered include the probabilities of exposing various parts or combinations of parts of the body to thermal radiation, and the military effectiveness of troops receiving given degrees of burns on various combinations of exposed body regions. (C.H.)

8253 UCLA-420

California. Univ Los Angeles. Atomic Energy Project. SEMI-ANNUAL PROGRESS REPORT FOR THE PERIOD ENDING DECEMBER 31, 1957. Jan. 15, 1958. 60p. Contract AT-04-1-GEN-12. $1.75(OTS).

Progress is reported in the following studies; the effects of irradiation on the products of lipid metabolism; the infrared absorption spectra of unsaturated steroids; the characteristics of tobacco mosaic virus particles; the effects of hydration on the radiosensitivity of bacteriophage; the effect of x irradiation on the developing limb buds of tadpoles and on the retina of lizards and tadpoles; the effects of x irradiation on muscle fatigue in rats; the toxicity and skin irritant effects of polyphenyl compounds used as reactor moderator-heat exchangers; chronic poisoning of rabbits subjected to repeated small doses of carbon tetrachloride; tracer studies on the gastrointestinal absorption of strontium sulfate by rats, rabbits, and guinea pigs; development of a method for separating polymorphonuclear neutrophils from lymphocytes; observations on radiation injuries, the early appearance of neoplasms, and the major causes of death in rats surviving 1000 r hypoxic total-body irradiation; development of procedures for the measurement of beta radiation skin dose from fresh fallout by means of special film pack dosimeters; the development of photographic film radiation dosimeters; the design and construction of a simplified low-cost extrapolation chamber; the development of design modifications for an electron microscope; the development of a time of arrival indicator for radioactive fall-out; and the development of chemical radiation dosimeters. Summaries are included of papers prepared for publication. (For preceding period see UCLA-399.) (C.H.)

8254 UCSF-16

California. Univ., San Francisco. School of Medicine. Radiological Lab.

SEMIANNUAL REPORT FOR PERIOD ENDING DECEMBER 31, 1957. Feb. 1958. 13p. Contract AT-11-1-GEN-10, Project No. 2. $0.50(OTS).

Clinical results are summarized for forty patients with various types of tumors treated with the x-ray beam from the 70-Mev synchrotron. Progress is reported in the development of chemical radiation detectors. Data are included from a study of the influence of postirradiation incubation temperature on x-ray sensitivity of microorganisms. A list of publications during the period is included. (For preceding period see UCSF-15.) (C.H.)

8255 AEC-tr-3171

FUNCTIONAL AND MORPHOLOGICAL CHANGES IN THE BRAIN UNDER THE EFFECT OF IONIZING RADIATION. K. A. Kyandaryan, S. A. Papoyan, A. G. Beglaryan, A. A. Zagatskaya, and R. K. Arutyunyan. Translated from Doklady Akad. Nauk S.S.S.R. 112, 249-52(1957). 7p.

Observations are reported on the general reaction and electro-encephalographic variations manifest in patients undergoing x ray therapy and in patients treated with internally deposited radioactive cobalt. Observations are also reported on the general reaction and electroencephalographic variations in rabbits having radiation sickness, and a pathological-anatomical investigation of the brain of rabbits following administration of lethal doses of x radiation. (C.H.)

8256

GASTRIC LESIONS IN EXPERIMENTAL ANIMALS FOLLOWING SINGLE EXPOSURES TO IONIZING RADIATIONS. G. Brecher, E. P. Cronkite, R. A. Conard, and W. W. Smith (National Inst. of Arthritis and Metabolic Diseases, National Cancer Inst., Naval Medical Research Inst., Bethesda, Md. and Brookhaven National Lab., Upton, N. Y.). Am. J. Pathol. 34, 105-19(1958) Jan.-Feb.

Epithelial changes in the gastric mucosa of dogs, rats, and hamsters developed following single supralethal exposures to irradiation. These changes were quite similar to those which occur earlier in the small intestine. Regeneration proceeded from the neck of the glands and was comparable to the regeneration of small intestine mucosa from surviving crypt epithelium. Occasionally, the direct damage was severe enough to lead to ulceration, even after local irradiation and in the absence of agranulocytosis and hemorrhage. This was in contrast to the late ulcers appearing in the regenerated mucosa of the small intestine which were associated with hemorrhage or represented direct sequelae of the pancytopenia that follows lethal irradiation. (auth)

8257

EFFECT OF X-RAY IRRADIATION ON MUSCLE FATIGUE IN RATS. Thomas J. Haley, A. M. Flesher, N. Komesu, E. F. McCulloh, and W. G. McCormick (Univ. of California, Los Angeles). Am. J. Physiol. 193, 355-9(1958) May.

With the Ingle fatigue test, it has been demonstrated that a loss of muscle responsiveness, increased fatigability and decreased work output follow acute whole-body irradiation. These effects increase with time postirradiation. In both normal and irradiated animals, strain differences were observed. In the dosage used, the administration of adrenal cortical extract did not improve performance. Adrenalectomy plus cortical extract did not improve performance. It has been postulated that the poor performance of the irradiated animals is related to a lack of glycogenolysis, poor intestinal absorption of glucose, and circulatory collapse. (auth)

8258

THE PRODUCTION OF TRANSLOCATIONS IN DROSOPHILA OOCYTES. D. R. Parker and Alice E. Hammond (Univ. of Mississippi, University). Genetics 43, 92-100(1958) Jan.

Attached-X female Drosophila oocytes of various ages were irradiated, and the frequency of detachment deter-

mined in females of various ages. There is an increase in radiation sensitivity of oocytes with aging up to three days, after which there is no evident increase. A two hit formation of detachments is found both in young and old oocytes. Dose fractionation experiments show breaks in stage 7 rejoin in about ten minutes, while those in stage 14 do not rejoin until fertilization. There is evidently a change in the proportions of the various kinds of exchanges obtained when females are aged before treatment. Speculations are made as to the possible role of cytochrome oxidase activity in the changing sensitivity of oocytes. (auth)

8259

THE COMPARATIVE EFFECTS OF HARD AND SOFT IONIZING RADIATIONS ON MALE AND FEMALE RING X DROSOPHILA IN AIR AND NITROGEN. Michael A. Bender (Johns Hopkins Univ., Baltimore). Genetics 43, 122-38(1958) Jan.

The rate of loss of ring X chromosomes in the progeny of x-irradiated male and female Drosophila was studied. It is shown that breakage, measured as ring loss, is less frequent in x-rayed oöcytes than in x-rayed sperms. A further study was made of the rates of ring loss in males and in females, in both air and nitrogen, induced by soft x rays and by hard γ rays. When x rays were used, these studies showed a small, but quite significant, effect of oxygen on ring loss in X^{c1}, y males, and a larger oxygen effect on ring loss in X^{c1}, y females. When γ rays were used, however, there was no demonstrable effect of oxygen on the frequency of ring loss in either sex. This result is interpreted in the light of the hypothesis of a spectrum of chromosome damage. (auth)

8260

TRANSPLANTATION OF HOMOLOGOUS ERYTHROPOIETIC ELEMENTS IN RATS AFTER SUBLETHAL DOSES OF X RADIATION. T. T. Odell, Jr. and B. C. Caldwell (Oak Ridge National Lab., Tenn.). J. Natl. Cancer Inst. 20, 851-8(1958) Apr.

The success of bone-marrow transplantation between homologous rats after several different doses of x radiation was studied. Long-lasting and extensive transplants of donor marrow were observed in about a fourth of the rats received 300 or 500 r of x rays (LD50/30 days, 725 r). There were no permanent transplants in rats that received 225 r or less, although a small number of the donor-type red cells were seen in the circulation for a few weeks in some animals. (auth)

8261

LINGERING EFFECTS OF LOCAL X-IRRADIATION ON HEALING OF BURNS. R. H. Rixon, J. M. A. Tishler, and H. B. Newcombe (Atomic Energy of Canada, Ltd., Chalk River, Ont., Can.). Nature 181, 1138-9(1958) Apr. 19.

Rats were exposed to (local cutaneous) x ray doses of 1,600 and 2,400 r and thermal burns were inflicted immediately and one. two. and three weeks after irradiation. Data indicate that x irradiation does not retard the healing of burns inflicted beyond one to two weeks after irradiation with the doses used and that radiation effects, when present, delay healing to twice its normal time. (C.H.)

8262

RADIOACTIVE RADIATIONS IN AGRICULTURE. L. P. Breslavets (Inst. of Biophysics, Moscow). Priroda 47, No. 3, 54-7(1958). (In Russian)

Radiation-induced plant mutations and effects of radiation on harvest yields of grain are discussed. (R.V.J.)

8263

EFFECT OF INTERNAL EMITTERS ON RED CELL AND PLASMA VOLUMES OF BEAGLE DOGS. John E. Parkinson and Jean H. Dougherty (Univ. of Utah, Salt Lake City). Proc. Soc. Exptl. Biol. Med. 97, 722-5(1958) Apr.

Simultaneous red cell and plasma volumes were measured with Cr^{51} and I^{131} in control beagle dogs and dogs with internally deposited radioisotopes. The reliability of the method is discussed. In isotope treated anemic dogs the venous hematocrit tended to be higher than the total-body or true hematocrit but more accurately reflected red cell volume changes than in controls. Plasma volume did not change to account for this relative increase in venous hematocrit. It is postulated that this relatively high venous hematocrit probably represents a shift of red cells into large caliber veins. (auth)

8264

INFLUENCE OF ANTIHISTAMINES ON MAST CELL DISRUPTION FOLLOWING X-IRRADIATION. Douglas E. Smith (Argonne National Lab., Lemont, Ill.). Proc. Soc. Exptl. Biol. Med. 97, 872-4(1958) Apr.

X irradiation was followed by evidence of marked damage to mast cells in mesentery, skin and cheek pouch of rat and hamster. Daily intraperitoneal injection of pyrilamine maleate largely prevented damage to mast cells in the mesentery but not to those in skin and cheek pouch of the irradiated hamster. Pyrilamine maleate offered no protection against damage to mast cells in tissues of the irradiated rat. Intraperitoneal injections of promethazine hydrochloride in low dosage failed to protect mast cells against radiation damage in any tissue of the hamster. In high dosages this compound destroyed mast cells of mesentery of the nonirradiated hamster, but did not affect those of skin and cheek pouch. (auth)

8265

POST TREATMENT MODIFICATION OF X-RAY INDUCED INJURY IN BARLEY BY AEROBIC AND ANAEROBIC HYDRATION. Richard S. Caldecott, C. F. Konzak, and Elizabeth Bindloss Johnson (Univ. of Minnesota, Minneapolis and Brookhaven National Lab., Upton, N. Y.). Radiation Research 7, 308(1957) Sept.

Seeds of barley with either 4% or 16% water in the embryo were given x ray doses ranging from 5000 r to 45,000 r. Immediately after treatment they were plunged into boiled distilled water and aerated with either oxygen or nitrogen and permitted to hydrate at room temperature from 5 minutes to 8 hours. After hydration they were plated out in petri dishes and grown for 6 days after which time seedling height measurements were made. The seeds having an embryo water content of 4% at the time of x radiation manifested different degrees of growth inhibition dependent upon whether hydration occurred in the presence of oxygen or nitrogen, the former resulting in the greatest injury. Nonirradiated controls evidenced no injury modification attributable to the condition of hydration. A significant injury modification occurred during only 5 minutes of hydration and the maximum effect took place during 30 minutes of hydration. Subsequent studies have shown that if seeds with 4% water in the embryos are stored for 6 hours after x radiation, before hydration is initiated, the injury modification reported does not take place. In this same connection, it has also been demonstrated that the greatest possible modification of injury occurs when the total dose of radiation is given in the shortest possible time. (auth)

Radiation Hazards and Protection

Refer also to abstract 8241.

8266 DP-105(Rev. 2)

Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.

ACCIDENTAL DISPERSION OF REACTOR POISONS AND

THE CONTROLLED DISTANCE REQUIRED. R. L. Menegus and H. F. Ring. Mar. 1958. 40p. Contract AT(07-2)-1. $1.25(OTS).

Two types of hypothetical reactor catastrophe are considered. In the first of these, the "Boiling Accident," it is assumed that a fraction of the radioactive material in a reactor is released to the atmosphere at a steady rate over a period of hours. In the second, the "Puff Accident," it is assumed that the release of the radioactive material takes place "instantaneously." The following concepts are used as measures of the hazard existing outside the controlled plant area: "Danger Distance," defined as that distance beyond which the fission product cloud becomes so dilute that it cannot cause death; "Probability of Death per Capita per Accident," which is a measure of the hazard to any individual; and "Expectation Number of Deaths per Accident," which is a statistical measure of the hazard to the entire off-site populace. Three mechanisms for each type of catastrophe were considered: direct irradiation from the fission product cloud, inhalation of the air in the cloud, and rainout from the cloud followed by irradiation from the ground. Fallout is not considered, for it requires that a very energetic explosion be assumed. It is concluded that the size of the plant should be set by the hazard of irradiation from the low-lying poison cloud produced in the boiling accident. A formula is proposed that permits the calculation of the controlled area that should exist around any reactor. Inversion and average meteorology are analyzed in terms of their effect on off-site hazard. The same theory, utilizing the concepts of the probability of death and the expectation number of deaths, is useful in estimating the hazard in the event a tank of H_2S, SO_2, or Cl ruptures, releasing to the atmosphere great quantities of gaseous poison. This problem is treated briefly at the end of the report. It is estimated that the escape of 1.4 million pounds of unignited hydrogen sulfide over a period of half an hour is equivalent in hazard to a 1000-Mw reactor that runs away and releases a cloud of fission products in which the decay heat is 2 Mw. (auth)

8267 DRCL-260

Canada. Defence Research Chemical Labs., Ottawa.
PROTECTION FACTORS FOR HOUSES USING RADIOACTIVE SOURCES. J. R. Cunningham, R. Wilson, F. A. Bury, and J. K. M. Flexman. Nov. 1957. 20p. Project No. D-89-16-80-15.

The shielding afforded by two types of dwellings to the gamma rays from a simulated infinite contaminated field has been studies. Both the basements and the ground floors of the houses were examined using both Co^{60} and Cs^{137} as contaminants. A method was devised whereby single sources were used. The sources were moved at a constant rate along lines parallel to the walls of the house and the dose rates recorded as a function of the position of the source along these lines. The area under these curves gave the dose rates from simulated line sources. The dose rates from these source lines were plotted against the distance from the house, the area under this curve giving the dose rate from a uniformly contaminated area surrounding the house. A similar method was used for determining the dose rates from the roof. The data obtained are given in the form of percentages of the dose rate received three feet above an open field contaminated by the same source density. The contributions from the ground within one hundred feet of the house, beyond one hundred feet, and from the roof are shown. (auth)

8268 KIR-195/58

Norwegian Defence Research Establishment, Oslo.
RADIOCHEMICAL ANALYSIS OF FALLOUT IN NORWAY. Communication No. 6. H. Bergh, G. Finstad, L. Lund, O. Michelsen, and B. Ottar. Jan. 1958. 9p.

Data are tabulated on the concentration of radioactive iodine, cesium, and strontium in samples of milk and radioactive strontium and cesium in samples of rain water and drinking water collected in Norway from October through December, 1957. Results are included from experiments on the absorption of radiostrontium and radiocesium from contaminated water with humus, aluminum hydroxide, Kieselguhr, and Dowex-50. (For preceding period see KIR-183/57.) (C.H.)

8269 NP-6639

Chicago. Univ. Air Force Radiation Lab.
QUARTERLY PROGRESS REPORT NO. 26. Jan. 15, 1958. 128p. Contract AF41(657)-25.

Sixty-six chemical compounds were tested for protective activity against the mortality and weight loss seen in mice exposed to 800 r of whole-body x irradiation. These included a series of aminoethyl isothiuronium derivatives, several dithiocarbamic acid, benzothiazole, and thiourea derivatives and numerous related and miscellaneous compounds. None of these compounds exhibited protective effects as great as had been obtained previously with other compounds. Data are presented graphically. Data are included from studies on the relative biological effectiveness of fast neutrons and cobalt-60 gamma irradiation in depressing citric acid accumulation in the spleens and thymus glands of rats; the biochemical and physiological effects of β-aminoethylisothiuronium in rats; and the incidence of cataract formation in mice exposed to fractionated low-level doses of gamma and fast neutron irradiation. (For preceding period see NP-6491.) (C.H.)

8270 NP-6672

Atomenergikomissionen, Denmark.
RADIOAKTIVITETEN I RISØ OMRÅDET. (Radioactivity in the Riso District.) K. Heydern, J. Lippert, and P. Theodorsson. Apr. 1, 1957. 87p.

Various methods of determining total beta activity in natural materials are discussed. With these methods the activity was determined for the water of the Roskilde fjord and the earth and plants of the Risø district. Daily measurements were made of the air and rainwater, and fewer measurements were made on the Roskilde fjord, fresh water, and milk. The activity found was from naturally occurring radioactive background or from fallout. For plants and rainwater the fall-out activity was the strongest. The variation of activity with time was determined. (J.S.R.)

8271

ON THE HAZARDS OF RADIATION FROM CONTINUOUS NUCLEAR BOMB TESTS. O. I. Leipunskii. Atomnaya Energiya 4, 63-70(1958) Jan. (In Russian)

The hazards from radioactive fall-out due to continuous nuclear bomb tests equivalent in intensity to 11 megatons of TNT are studied. Concentrations of Sr^{90} in the bones, the rate of leukemia, and the number of the victims of genetic damage are evaluated. The calculations show that towards the end of the century the concentration of Sr^{90} in the spine in large groups of the population could exceed the officially permissible dose and each year of continuous tests would result in the birth of 44,000 persons burdened by hereditary sickness, and 29,000 cases of leukemia. (tr-auth)

8272

SHIELDING DATA FOR GAMMA RADIATION. K. Sauerwein (Institut Düsseldorf der Isotopen-Studiengesellschaft, Düsseldorf). Atomwirtschaft 3, 103-10(1958) Mar. (In German)

The necessary thickness of the shielding material and the minimum distance from the radiation source must be of such magnitude that a person in the vicinity does not

receive more than the highest permissible dose of 0.1 r per week. The calculation of these parameters depends on the intensity and energy of the gamma radiation. Calculation of shielding requirements is given. The accumulation factor in radiation dosage is considered. A comparison of the theoretical with the measured requirements is made, and the practical application of the calculated requirements is discussed. (J.S.R.)

8273

EFFECTS OF CYANIDE AND IONISING RADIATION ON THE ROOTS OF VICIA FABA. Lorna J. Lilly (The Univ., Sheffield, Eng.). Exptl. Cell Research 14, 257-67(1958) Apr.

An investigation has been made of the radiomimetic and radiomodifying action of cyanide on the roots of Vicia faba. Cyanide treatment alone causes inhibition of growth and mitosis, and an increase in the number of abnormal anaphases. These effects are most pronounced in conditions of high oxygen tension. When cyanide is used in conjunction with x-rays, there is an increased inhibition of growth and mitosis, and an increase in the number of abnormal anaphases. These effects occur when the experiments are conducted with nitrogen bubbling. In contrast, when the experiments are made with oxygen, cyanide does not increase radiation damage. Cyanide does not appear to modify the action of α-particles on Vicia roots. Various hypotheses have been considered in relation to these experimental results. (auth)

8274

BASIC METHODS OF PROTECTION IN HANDLING CLOSED RADIOISOTOPE CONTAINERS. Henryk Kowalski. Nukleonika 3, 95-100(1958). (In Polish)

8275

ESTIMATION OF EFFECT OF RADIATION UPON HUMAN HEALTH AND LIFE SPAN. H. B. Jones (Univ. of California, Berkeley). Proc. Health Phys. Soc. 114-26(1957).

The effect of radiation upon human health and life span are discussed and compared with other environmental and socio-economic factors affecting human health and life span. (J.S.R.)

8276

CURRENT SAFETY PROBLEMS AT THE COSMOTRON. M. R. Beebe (Brookhaven National Lab., Upton, N. Y.). Proc. Health Phys. Soc. 217-26(1957).

A survey of the radiation from the Cosmotron has shown that the shielding is inadequate from a safety standpoint. At present local shieldings are piled up where necessary As present plans call for an increase in the beam intensity, either the control rooms and experimental areas will have to be moved to a remote location or an effective shielding arrangement will have to be made. (J.S.R.)

8277

THE BIOLOGICAL BASIS OF RADIATION PROTECTION. H. Langendorff (Univ. of Freiburg i. Br. and Heiligenberg-Institutes, Heiligenberg/Baden, Germany). Radiol. Clin. 26, No. 5, 260-71(1957) Sept. (In German)

The biological factors such as age and sex of the irradiated object as well as the kind and structure of the cells which affect response to radiation are briefly reviewed. The various approaches to radiation protection by biological methods are discussed, and the experimental results of many tests on different animals are reviewed. (J.S.R.)

8278

THIRD REPORT ON THE STUDIES OF RADIOACTIVE PRECIPITATION. T. A. Brody, Fernando Alba A., Ricardo Cameras, Adelaida Palacios, George Rickards C., Ariel Tejera R., and Enriqueta G. B. de Velarde (Universidad Nacional Autónoma de México). Rev. mex. fís. 7, 1-25 (1958). (In Spanish)

Fall-out data covering the period March to October 1957, for thirteen stations in the Mexican Republic are presented. Approximate figures for infinite γ doses and strontium-90 precipitation are deduced. Methods and preliminary results of strontium-90 and cesium-137 determinations in milk are described. (auth)

8279

TRAINING OF DOCTORS IN RADIATION PROTECTION METHODS BY THE GERMAN RED CROSS. Hanns Langendorff (Univ. of Freiburg i. Br.). Röntgen Bl. 10, No. 11, 345-50(1957) Nov. (In German)

A comprehensive survey is given of the training schedule available for radiologically trained physicians, who by the initiative of the German Red Cross and with the aid of that institution, receive supplementary training in the protection against the effect of x rays in all-day courses lasting 4 months. Participants in the course are simultaneously orientated about the necessary precautions in the application of radioactive substances. (tr-auth)

8280

BULLETIN OF THE ATMOSPHERIC RADIOACTIVITY. NUMBER 11 FOR OCTOBER-DECEMBER, 1957. Tokyo, The Japan Meteorological Agency, 1958. 86p. (In English and Japanese)

Data are tabulated on the radioactivity in samples of rain water and atmospheric dusts collected at various stations throughout Japan from October through December, 1957. (C.H.)

Radiography

8281

PREPARATION OF XENON-133 RADIOGRAPHY SOURCES FROM SPENT FUEL. E. J. Wilson, H. P. Dibbs, S. Richards, and J. D. Eakins (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucleonics 16, No. 4, 110, 112-14(1958) Apr.

Radioisotopes can often be used in radiography where the conventional x-ray machines are inconvenient or inapplicable. Xe^{132}, a fission product gas of quite high specific activity, offers many advantages in this field. The source is prepared by dissolving an irradiated uranium slug and condensing the inert gases present in a liquid-nitrogen cooled charcoal trap. All gaseous impurities except the inert gases are removed. The argon is removed by fractional desorption from charcoal, leaving the xenon. The xenon is then adsorbed on small plugs of fine-mesh activated charcoal embedded in a hard-glass capillary tube. (J.S.R.)

8282

A PORTABLE THULIUM-170 X-RAY UNIT. E. W. Coleman (Univ. of Michigan, Ann Arbor). Proc. Health Phys. Soc. 8-14(1957).

The design of a pilot model of a portable Tm^{170} x-ray unit is described. On the basis of the information gained from this model, a field model was built. The field model utilizes two shutters, a safety shutter and a radiographic shutter. The model is described in some detail. Although the radiographs obtained with the isotopic units are inferior to those obtained with electronic machines, they are capable of indicating gross fractures and foreign bodies. (J.S.R.)

Toxicology Studies

8283 HW-55292

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

EFFECT OF SEPARAN ON RAINBOW TROUT. P. A. Olsen and R. F. Foster. Mar. 11, 1958. 6p. Contract [W-31-109-Eng-52]. $1.80(ph OTS); $1.80(mf OTS).

Rainbow trout were continuously exposed to levels of 0.035 and 0.070 ppm of Separan for a four month period. No mortality was experienced. No growth retardation was evident in the lot exposed to 0.035 ppm and only slight retardation occurred at 0.070 ppm. Under current plant operating conditions, actual concentrations in the Columbia River approach only one-thirtieth of the lesser concentration. Thus there is no evidence of harm to fish life in the Columbia River resulting from the use of this material in the water plants. (auth)

8284

THE STATUS OF BIOASSAY TECHNIQUES FOR EVALUATION OF INTERNAL EXPOSURES FROM RADIOACTIVE ISOTOPES. J. W. Healy (General Electric Co., Richland, Wash.). Proc. Health Phys. Soc. 21-32(1957).

The interpretation of bioassay data in terms of the quantity of radioisotopes in the body is dependent upon the knowledge of the excretion rate of the substance by the human following acute administration. Other cases including chronic uptake and lung deposition may be evaluated from the acute case if other physical parameters are known. At the present time, one function of the bioassay laboratory should be the accumulation of data from any accidental exposures so that values for the parameters involved may be obtained for the human. (auth)

8285

THE DISTRIBUTION AND EXCRETION OF URANIUM IN MAN. S. R. Bernard, J. R. Muir, and G. W. Royster, Jr. (Oak Ridge National Lab., Tenn.). Proc. Health Phys. Soc. 33-48(1957).

The critical organ for radiation insult from storage of enriched uranium is the kidney when exposure is to a soluble substance. The disappearance of uranium from the body shows a slight dependence upon the amount injected into the bloodstream. The urinary excretion data can be described using the power function law. Integration of this function yields the retention as a function of time. The calculated retention agrees more closely with the retention in the critical organ than with retention in the body. A tentative MPC for exposure to soluble compounds is calculated to be 4×10^{-11} μc/cc on the basis of the power function equation. A tentative MPC for urine is calculated using the power function law. The calculated value is 355 d/m/day, a factor of 5 greater than the present value employed, thereby indicating a margin of safety for exposure to soluble compounds. (auth)

8286

CORRELATION BETWEEN URANIUM AIR DUST SURVEYS AND URANIUM URINE DATA. R. L. Hoover (National Lead Co. of Ohio, Cincinnati). Proc. Health Phys. Soc. 49-52(1957).

In assessing air dust problems associated with the handling of uranium, a good correlation was found between air dust levels and uranium urine data. Two typical cases of incident exposures are presented as examples. (J.S.R.)

8287

NUCLEAR TRACK TECHNIQUE FOR LOW LEVEL PLUTONIUM IN URINE. L. C. Schwendiman and J. W. Healy (General Electric Co., Richland, Wash.). Proc. Health Phys. Soc. 53-60(1957).

A method for analyzing urine samples for very small quantities of plutonium has been developed. The method requires evaporation of the urine sample, muffling, precipitation, and an extraction with thenoyltrifluoroacetone (TTA). The plutonium is subsequently electrodeposited on a 7 mm diameter area. The disc so prepared is held against a nuclear track emulsion for 168 hours. Techniques were perfected for preparing, processing, and microscopic examination of the emulsion. The detection limit of less than 0.05 d/m per sample currently achieved on a routine basis is low enough to permit early recognition of incipient plutonium deposition. (auth)

8288

ACUTE UPTAKE OF PLUTONIUM AND URANIUM FOLLOWING WOUND CONTAMINATION. E. L. Geiger and S. M. Sanders, Jr. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Proc. Health Phys. Soc. 61-6(1957).

Urinary excretion of plutonium during a 487-day period after an acute uptake by wound contamination was followed by the analyses of 99 urine samples. The data may be approximated by the function $Y = 141\ t^{-1.07}$ where Y is the plutonium disintegrations per minute in a daily voiding after t days. The probability that the Langham equation for the excretion of plutonium fits the Savannah River Plant data as well as the above equation is only 1 in 1,000. The data, however, differed no more from the Langham equation, which is a mean equation, than data from some of the cases used to calculate the mean. Zirconium citrate solution, administered intravenously approximately 3 hours after the accident, and Ca-EDTA, administered intravenously during the first 6 days after the accident, produced only a slight increase in the rate of plutonium excretion. Ca-EDTA was again administered on the 131st to 135th days after the accident and only a slight increase in the rate of plutonium excretion was observed. A second case followed was that of an employee hospitalized for burns caused by hot uranyl nitrate solution. Contrary to excretion data obtained from persons injected with soluble uranium, the excretion rate in this case decreased only slowly for the first 9 days following the accident. Between the ninth and fifteenth days, however, the daily excretion rate dropped a hundredfold. From the fifteenth to the fortieth day, the biological half-life for elimination was approximately 6 days. The data may indicate that the uranium was leached slowly from the burned tissue into the blood. (auth)

8289

MEASUREMENT OF RETENTION AND EXCRETION OF RADIOISOTOPES OF THE ALKALI METALS BY MICE AND RATS, USING AN ANNULAR LIQUID SCINTILLATION COUNTER. K. T. Woodward, C. R. Richmond, and W. Langham (Los Alamos Scientific Lab., N. Mex.). Proc. Health Phys. Soc. 79-88(1957).

Measurements of Na^{22}, K^{42}, Rb^{86}, and Cs^{134} retention in rats and mice are given. Measurements of Cs^{134} retention in one man following oral administration are also given. The retention was studied in vivo by use of an annular liquid scintillation counter. (J.S.R.)

8290

THORIUM MAXIMUM PERMISSIBLE AIR CONCENTRATIONS AND AIR SAMPLING PROBLEMS. J. W. Healy (General Electric Co., Richland, Wash.). Proc. Health Phys. Soc. 177-87(1957).

A review of some of the possible radiological problems involved in the handling of thorium was made. The maximum permissible body burden and the MPC in water and in air are given. The uncertainties in the calculation are discussed. The problems of air sampling are discussed in detail. It is evident that unless the concentration of the

daughter elements are low, counting measurements are of limited application to the measurement of thorium. (J.S.R.)

8291

INHALATION FROM URANIUM CONTAMINATED CLOTHING. J. C. Bailey, A. F. Becher, and H. F. Henry (Oak Ridge Gaseous Diffusion Plant, Tenn.). Proc. Health Phys. Soc. 188-91(1957).

In order to determine realistic uranium contamination limits for clothing, an extensive series of tests was performed to evaluate the actual inhalation hazard associated with uranium contaminated clothing. It was determined that if protective clothing is necessary, respiratory protection is much more important. (J.S.R.)

8292

CHANGES IN RENAL FUNCTION IN RATS DRINKING HEAVY WATER. John F. Thomson and Florence J. Klipfel (Argonne National Lab., Lemont, Ill.). Proc. Soc. Exptl. Biol. Med. 97, 758-9(1958) Apr.

Glomerular filtration and renal plasma flow were decreased to about 40% of normal in rats drinking 50 mole % D_2O. Upon transfer from D_2O to H_2O, renal function rapidly returned to normal. It is probable that the changes in renal function do not represent a direct toxic action of D_2O on the kidney, but are perhaps the result of disturbed adrenal function. (auth)

Tracer Applications

8293 HW-52285

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

DEPOSITION AND RETENTION OF Ru^{106} FOLLOWING ADMINISTRATION OF $Ru^{106}O_2$ TO MICE BY INHALATION AND INTRATRACHEAL INJECTION. W. J. Bair, L. A. Temple, D. H. Willard, J. L. Terry, and A. Graybeal. Oct. 1, 1957. 24p. Contract W-31-109-Eng-52. $0.75 (OTS).

The deposition and retention of Ru^{106} in mice following inhalation of $Ru^{106}O_2$ as dust and as a fog were studied for two days following exposure. Almost 25% of the ruthenium oxide inhaled was present in the lungs immediately after exposure. This was reduced by half in 24 hours. The remainder was removed from the lung at a much slower rate. Inhalation of ruthenium oxide particles was compared with administration by intratracheal injection. Inhalation produced more uniform distribution of particles in the lung than did administration by intratracheal injection and much greater distribution of Ru^{106} to tissues other than the lung. This was attributed to the larger quantities of particles passing through the gastrointestinal tract. The turnover of intratracheally administered particles from the lungs was negligible the first two days. (auth)

8294 UR-512

Rochester, N. Y. Univ. Atomic Energy Project.

ON THE MECHANISM OF SKELETAL FIXATION OF STRONTIUM. J. Boyd, W. F. Neuman, and H. C. Hodge. Nov. 14, 1957. 16p. Contract W-7401-eng-49. $3.30 (ph OTS); $2.40(mf OTS).

The results of the present investigations permit a provisional description of the mechanisms underlying the skeletal fixation of strontium. Strontium ions from the extracellular fluids, diffusing into the bone areas, enter into the hydration jackets surrounding the individual bone crystals and exchange with certain calcium ions in the surfaces of mineral crystals. With passing time, these strontium ions become incorporated to some extent within the crystals, presumably as the result of thermal diffusion and recrystallization. (auth)

CHEMISTRY

8295 AECU-3663

Purdue Univ., Lafayette, Ind.

THE CHEMISTRY AND NUCLEAR CHEMISTRY OF THE HEAVY ELEMENTS. Progress Report No. 3. J. W. Cobble, ed. Mar. 1958. 98p. Contract AT(11-1)-347. $18.30(ph OTS); $6.00(mf OTS).

The standardization and techniques of 4π counters used for counting isotopes are described. The design, construction, and operation of a $4\pi\ \beta-\gamma$ coincidence counter are described. A 2π proportional counter for determining absolute fission yield was calibrated. The use of $4\pi\ \gamma$ scintillation counting as a method for determining absolute disintegration rates was investigated. Thin uniform targets were prepared by electrodeposition for cyclotron bombardment. The cyclotron bombardment of U^{238} at different energies and attempts to isolate the resulting fission products chemically are described. A step-wise flow diagram for the separation of fission products (radiochemically) from the cyclotron bombardment of uranium isotopes is presented. A program is reported which will cover independent yields from fission of U^{233}, U^{235}, and U^{238} with 20 to 50 Mev alpha particles from the Argonne National Lab. 60-inch cyclotron. A block diagram of the radiochemistry involved in the separation of fission products from the bombardment of U^{233}, U^{235}, and U^{238} with alpha particles is presented. The work on measurement of the UO_2^{2+}/UO_2^{2+} potential was continued. The design of the glass and tantalum calorimeters is described along with heating circuit, vacuum line, and thermistor bridge. (W.L.H.)

8296 HEC-88

Hooker Electrochemical Co., Niagara Falls, N. Y.

DEGRADATION AND PASSIVATION OF ELEMENTAL BORON. George T. Miller. Apr. 18, 1958. 9p. Contract AT(30-1)-1524. $1.80(ph OTS); $1.80(mf OTS).

Elemental boron was found to degrade during processing and storage by adsorbing gases and water vapor. Heating to 700°C in an inert atmosphere greatly increased the rate of adsorption. It was found that the boron could be passivated by drying in an oxygen atmosphere, under vacuum at 100°C. (auth)

8297 HW-55353

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A SOLIDS FILTER FOR HOT CORROSIVE GASES. G. A. Nicholson. Mar. 14, 1958. 4p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

The unit was used to remove suspended solids of 1.5 microns average particle size from a hot dry air stream. The pressure drop across the clean filter was 1.2 lb/sq. in./in. of filter thickness. The filter gave very good performance. Absolute removal of solids was obtained. Cake deposits of approximately 0.03-inch thickness were obtained with only a 75 per cent increase in the pressure drop. Essentially complete removal of the cake was accomplished by a sudden reversal of the gas flow. (auth)

8298 ISC-74

Ames Lab., Ames, Iowa.

QUARTERLY SUMMARY RESEARCH REPORT FOR JULY, AUGUST, AND SEPTEMBER 1949. W. E. Dreeszen. Feb. 15, 1950. Decl. Mar. 4, 1957. 33p. Contract W-7405-eng-82. $6.30(ph OTS); $3.00(mf OTS).

The separation of the rare earth groups cerium and yttrium by ion exchange is described. The silica gel adsorption separation of Zr from Hf using acetone as a solvent is described. A complete structure determination

of the face-centered cubic compound $Th_{24}Mn_{92}$ was carried out. Brief miscellaneous investigations are also reported. (W.L.H.)

8299 ISC-923
Ames Lab., Ames, Iowa.
SURFACE TENSIONS OF SOME BINARY FUSED SALT SYSTEMS. June L. Dahl and F. R. Duke. June 1957. 82p. Contract W-7405-eng-82. $2.25(OTS).

The surface tensions of eight pure fused salts: $NaNO_3$, KNO_3, LiCl, NaCl, $PbCl_2$, KCl, and $ZnCl_2$ and nine binary mixtures: $NaNO_3-KNO_3$, $AgNO_3-NaNO_3$, $AgNO_3-KNO_3$, NaCl–KCl, $PbCl_2$–LiCl, $PbCl_2$–NaCl, $PbCl_2$–KCl, $PbCl_2$–RbCl, and $PbCl_2$–CsCl were measured by the maximum bubble pressure method. Surface tension showed essentially linear variation with temperature in all cases. (W.L.H.)

8300 KAPL-1740
Knolls Atomic Power Lab., Schenectady, N. Y.
THERMAL STABILITY OF HYDROUS ALUMINUM OXIDES. F. J. Shipko and R. M. Haag. July 10, 1957. 33p. Contract W-31-109-Eng-52. $1.00(OTS).

The decomposition of the various hydrous oxides of aluminum has been studied under static conditions. At low pressure, the more highly ordered structures are believed to have been measured in thermodynamic equilibrium. The pressure range observed, however, is too short to permit precise evaluation of thermodynamic quantities. The less ordered structures do not give clearly defined decomposition pressures. At higher pressures, the physical resorption of water prevents any thermodynamic interpretation of the data. The different modifications of hydrous alumina prepared by different methods are compared and their structures are related to the method of preparation. (auth)

8301 NACA-TN-4089
Lewis Flight Propulsion Lab., Cleveland.
THE MECHANISM OF THERMAL-GRADIENT MASS TRANSFER IN THE SODIUM HYDROXIDE–NICKEL SYSTEM. Charles E. May. Sept. 1957. 54p.

"Thermal-gradient mass transfer" was investigated in the molten sodium hydroxide–nickel system. Kinetic equations are theoretically derived. Possible mechanisms (physical, electrochemical, and chemical) are discussed. The following mechanism is found to be most probable: $Na_2NiO_2 + 2Na \underset{\text{Hot zone}}{\overset{\text{Cold zone}}{\rightleftharpoons}} 2Na_2O + Ni$. This mechanism requires that the chemical reaction is the rate-determining step in dynamic systems and that the diffusion process is the rate-controlling step in static systems. Beneficial and detrimental effects of additives are interpreted in terms of the probable mechanism. (auth)

8302 NDA-84-6
Nuclear Development Corp. of America, White Plains, N. Y.
CHEMICAL CONSIDERATIONS IN THE SODIUM-COOLED, D_2O-MODERATED REACTOR (SDR). Apr. 30, 1958. 22p. Contract AT(30-3)-256. $3.30(ph OTS); $2.40 (mf OTS).

A careful review of the literature has shown that sodium and water systems can be designed for safety against a reaction between the two fluids. Adherence to basic safety design rules developed from operating experience prevents shock wave formation and high temperature peaks. Adequate surge volume and oxygen exclusion by means of inert gas blanketing are the most important considerations. (auth)

8303 NYO-7928
Aeroprojects, Inc., West Chester, Penna.
APPLICATIONS OF ULTRASONIC ENERGY. Progress Report No. 8 Covering Period from February 1, 1958 to March 31, 1958. Apr. 1958. 59p. Contract AT(30-1)-1836. $9.30(ph OTS); $3.60(mf OTS).

Precipitation of thorium oxalate carried out under ultrasonic influence was investigated using three techniques: addition of solid oxalic acid to thorium nitrate solution; mixing of solutions of oxalic acid and thorium nitrate; and mixing of solid oxalic acid and solid thorium nitrate, with subsequent addition to water under ultrasonic influence. Parameters of reagent concentration, solution temperature, rate of addition of precipitant, duration of ultrasonic treatment, and mechanical agitation are being investigated. The smallest and most uniform thorium oxalate particles to date were produced by fast addition of solid oxalic acid to thorium nitrate solution at low temperature, with short (5 to 7 minutes) ultrasonic treatment time; the particles thus produced were generally less than 1 micron diameter, with a very few as large as 2 microns. Studies were continued in the ultrasonic dissolution or disintegration of fuel-element materials in mercury. A suitable coupler material appears to be heat-treated Allegheny-Ludlum DBL-2 tool steel, which successfully withstood more than 40 hours of ultrasonic application in molten mercury with no evidence of erosion. Ultrasonic dissolution of representative materials (thorium, powdered iron compacts, and Type 304 stainless steel) in mercury at room temperature was found in preliminary tests to be significantly greater in all cases than that achieved without ultrasonic application. Ultrasonic leaching of cesium-bearing alumina waste with 0.01 N nitric acid, using batch-type treatment in a "fixed-bed" cylindrical vessel operating at a frequency of 20 kc and a low (50 watts) power level, was considerably more effective than comparable non-ultrasonic leaching. In a control test, only about 5% of the cesium was removed in 3 hours, while 35 to 50% was removed in the same time under ultrasonic influence. Investigations oriented to ultrasonic agglomeration of submicron radio-active particles in dilute gas streams, using an additive liquid aerosol to aid in coalescence, were continued. A very dilute aerosol of solid potassium chloride particles which could be analyzed by flame photometry was used as a simulant. The dense additive liquid aerosol was a non-evaporating glycerine-water mixture prepared in the optimum size range for the promotion of agglomeration. Preliminary experiments with an 8-foot-long ultrasonic agglomeration chamber through which the aerosol was drawn at low flow rate indicated order of magnitude improvement in fallout of potassium chloride particles when an ultrasonic standing-wave field was imposed upon this aerosol after a dense aerosol of non-evaporating glycerine had been mixed with it. Assembly and preliminary test of an annular agglomeration chamber, utilizing a relatively uniform, high-intensity acoustic pattern produced by a center-mounted, modified Hartmann whistle, indicated the production of annular standing waves and the possibility of highly effective agglomeration. (For preceding period see NYO-7927.) (auth)

8304 WADC-TR-56-207(Pt. III)
Denver. Univ. Denver Research Inst.
"CHAIN TYPE" POLYPHENYL AND POLYNUCLEAR AROMATIC COMPOUNDS AS BASE MATERIALS FOR HIGH TEMPERATURE STABLE AND RADIATION RESISTANT LUBRICANTS AND HYDRAULIC FLUIDS. Period covered: October 1956 to December 1957. Josef J. E. Schmidt, John A. Krimmel, and Thomas J. Farrell, Jr. 142p. Project No. 7340. Contract AF33(616)-2939.

This report describes the preparation and investigation of alkylbiphenyl and alkylterphenyl derivatives and their intermediates. In particular, homologous series of 4'

-alkyl-m-terphenyl and 3-alkyl-m-terphenyl compounds have been prepared in connection with a closer investigation of the correlations between chemical structure of these classes of compounds and their physical properties, thermal stability, and their feasibility as thermally stable and radiation resistant fluids. Two half-gallon samples of the more promising fluids, 4' -n-nonyl-m-terphenyl and 3-n-heptyl-m-terphenyl, have been prepared for WADC's Materials Laboratory under contractual terms for the purpose of additional testing. (auth)

8305 NP-tr-64

THE BINDING OF POTASSIUM BY CARBON. Karl Fredenhagen and Gustav Cadenbach. Translated by S. Asher from Z. anorg. u. allgem. Chem. 158, 249-63 (1926). 9p.

Potassium, rubidium, and cesium act strongly on carbon in the form of graphite, soot, and active carbon. The effect is shown by the disruption of the carbon used and the production of heat. Products can be isolated whose compositions are practically constant for definite regions of pressure and temperature. The amount of alkali metal bound changes approximately in the ratio of 1:2:4, that is, one mol of alkali metal is bound by about 16 or 8 or 4 mols of carbon. Here the last stage corresponding to the complete saturation is the least limited. (auth)

8306

ISOTOPE EFFECT AND STRUCTURE OF THE B_2O_3 AND B_4O_6 MOLECULES. William J. Taylor (Ohio State Univ., Columbus). J. Chem. Phys. 28, 625-9(1958) Apr.

A systematic application of the Teller-Redlich product rule to the isotope effect has been carried out for several of the most likely structures of the B_2O_3 molecule, and tetrahedral B_4O_6. It is pointed out that an isotope effect of the magnitude reported by Dows and Porter in the infrared emission (2013 and 2114 cm^{-1} for $B_2^{11}O_3$ and $B_2^{10}O_3$, respectively) is incompatible with the bipyramidal (D_{3h}) model they consider, as well as with the linear ($D_{\infty h}$) structure. Less symmetrical structures of B_2O_3 (C_2, C_{2v}, and C_{3v} symmetries) are not excluded; neither is the tetrahedral B_4O_6 structure. These conclusions are reached by using in conjunction with the product rule the theorem that the frequency of each and every vibrational mode of a molecule is a monotonic function of each atomic mass. This makes it possible to set bounds on the isotope effect of individual modes of each symmetry type, and this procedure should be generally useful. A proof of the theorem stated is given. (auth)

8307

VAPOUR PRESSURE OF TITANIUM TETRABROMIDE. Elton H. Hall, John M. Blocher, Jr., and Ivor E. Campbell (Battelle Memorial Inst., Columbus, Ohio). J. Electrochem. Soc. 105, 271-5(1958) May.

Measurements were made of the vapor pressure of $TiBr_4(l)$. The following results were obtained: $TiBr_4(l) = TiBr_4(g)$, $\log P_{atm} = -3706.29/T - 6.2424 \log T + 24.199$, $P = 1$ atm at 506.6°K, $\Delta H_{298.2} = 13.22 \pm 0.10$ kcal, $\Delta H_{506.6} = 10.60 \pm 0.10$ kcal, $\Delta S_{298.2} = 27.58 \pm 0.22$ e. u., $\Delta S_{506.6} = 20.93 \pm 0.22$ e. u. Combination of the above data and thermal data with the calculated entropy of $TiBr_4(g)$ gave the standard entropy: $TiBr_4(s)$, $S^0_{298.2} = 57.6 \pm 0.22$ e.u. This value agrees with Kelley's value 57.2 ± 0.9 e. u. obtained from low-temperature heat-capacity measurements. (auth)

8308

VAPOR PRESSURE OF TITANIUM TETRAFLUORIDE. Elton H. Hall, John M. Blocher, Jr., and Ivor E. Campbell (Battelle Memorial Inst., Columbus, Ohio). J. Electrochem. Soc. 105, 275-8(1958) May.

Measurements were made of the vapor pressure of $TiF_4(s)$. The following results were obtained: $TiF_4(s) = TiF_4(g)$, $\log P_{atm} = -5331.51/T - 2.567 \log T + 16.631$, $P = 1$ atm at 556.3°K, $\Delta H_{298.2} = 22.87 \pm 0.28$ kcal, $\Delta H_{556.3} = 21.55 \pm 0.28$ kcal, $\Delta S_{298.2} = 41.92 \pm 0.40$ e. u., $\Delta S_{556.3} = 38.74 \pm 0.40$ e. u. Combination of the above data and thermal data with the calculated entropy of $TiF_4(g)$, $S^0_{298.2} = 73.2$ e. u., gave the standard entropy: $TiF_4(s)$, $S^0_{298.2} = 31.3 \pm 0.40$ e. u. (auth)

8309

FORMATION OF THE DELTA-PHASE BY OXIDATION OF α-TITANIUM. I. Koncz and M. Koncz-Déri (Polytechnical Univ., Budapest). Periodica Polytechnica Chem. Eng. 1, 67-87(1957).

The oxidation of iodide titanium was studied at a temperature range of 570 to 820°C, and a pressure range of 2 to 5 mm Hg in pure oxygen, for periods up to 210 minutes. Dense, adherent oxide layers show rectifying properties, the presence of δ-phase titanium in these layers was stated and verified by x-ray analysis with tetragonal cell dimensions: a = 3.20 A, c = 5.12 A, c/a = 1.600. The diffusion coefficient of oxygen in α-Ti is determined at 840°C as 5×10^{-11} cm^2 sec^{-1}. A possible explanation for the mechanism of the oxidation process is given. (auth)

Analytical Procedures

8310 AERE-HP/M-126

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

MEASUREMENTS OF ^{137}Cs IN HUMAN BEINGS IN THE UNITED KINGDOM, 1956/1957. J. Rundo. Jan. 1958. 5p. $0.21(BIS).

A method of determining the radiocesium content of the human body using thallium-activated sodium iodide crystals and gamma-ray spectrometry is described, and results are presented for subjects measured between June 1956 and July 1957. The potassium content was determined simultaneously and the mean content of 16 adult males was 0.21% of body weight. The mean cesium content of these subjects was 34.0 μμc per g potassium with a standard deviation of 7.6 μμc per g. (auth)

8311 BLG-14

Brussels. Centre d'Etude de l'Énergie Nucléaire.

ANALYSE DES ALLIAGES URANIUM-ALUMINUM. (Analysis of Uranium-Aluminum Alloys.) P. Mechelynck. Sept. 30, 1957. 8p.

A simplified, but precise, gravimetric method for the determination of uranium and aluminum in alloys having uranium content of less than 25% is presented. The method is based on the complexing of uranium with carbonate ions, precipitation of aluminum hydroxide, and then precipitation of the uranium with ammonia. Ammonium carbonate, added to the acid solution of the alloy, lowers the pH to 7, complexes the uranium, and then precipitates the hydroxide of aluminum. The filtrate is acidified and boiled to remove the carbonate ions. The uranium is precipitated with an excess of ammonia. (J.S.R.)

8312 IGO-AM/W-113

United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England.

THE DETERMINATION OF 14 CARBON IN REACTOR COOLANT GAS. Feb. 1958. 10p. $0.45(BIS).

A sample of the gas is absorbed in saturated barium hydroxide solution. Carbon dioxide is regenerated from the barium carbonate, purified, and counted in a β proportional counter. The method is designed for the determina-

tion of carbon-14 in the coolant gas of reactors of the Calder Hall type. The chemical preparation is classical procedure. Some development work was undertaken on the counting procedure at Chemical Services Department, Windscale. (auth)

8313 IGO-AM/W-114

United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England.
THE DETERMINATION OF 131 IODINE IN THYROID GLANDS. Feb. 1958. 8p. $0.27(BIS).

Radio-iodine, together with sodium iodide carrier, is separated by extraction into carbon tetrachloride as elemental iodine, and back extraction into dilute sulfurous acid, as iodide. After precipitation as the silver salt and suitable mounting, the β activity of the iodide is measured and the observed dpm is corrected for chemical yield and the activity of the original sample is expressed as dpm or as $\mu\mu$c by comparison with a standard iodine 131 source. The method may be applied to various thyroid gland samples. (auth)

8314 IGO-AM/W-116

United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England.
THE GRAVIMETRIC DETERMINATION OF URANIUM IN URANYL NITRATE SOLUTIONS (AFTER SEPARATION BY ETHER EXTRACTION). Mar. 1958. 6p.

A procedure is outlined for the gravimetric determination of uranium in uranyl nitrate solutions as U_3O_8 after separation from impurities by extraction into ether. The method is suitable for the routine assay of uranium solutions containing calcium, aluminum, magnesium, fluoride, etc. (J.E.D.)

8315 ISC-781

Ames Lab., Ames, Iowa.
SPECTROPHOTOMETRIC DETERMINATION OF ZINC AND OTHER METALS WITH α, β, γ, δ-TETRAPHENYLPORPHINE. Ramon Edward Bisque and Charles V. Banks. June 1956. 32p. Contract W-7405-eng-82. $1.00(OTS).

Analytical procedures for the determination of trace amounts of zinc in various metals were developed utilizing the spectrophotometric properties of the zinc complex of α, β, γ, δ-tetraphenylporphine in glacial acetic acid. The metals to which these determinations are applied are those soluble in acetic or formic acid or those whose oxides are soluble in these acids. One application deserving of particular mention is the spectrophotometric determination of trace amounts of zinc in cadmium metal. A procedure for an indirect determination of other metals is presented. (auth)

8316 KAPL-M-JTP-1

Knolls Atomic Power Lab., Schenectady, N. Y.
THE POLAROGRAPHIC DETERMINATION OF TIN IN ZIRCONIUM ALLOYS. J. T. Porter, II. May 25, 1956. 7p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80 (mf OTS).

A polarographic method was developed for the determination of tin in zirconium at concentrations as low as 0.05%. The method is applicable in the presence of iron and molybdenum, interference being eliminated by reduction with iron powder prior to polarographic analysis. (auth)

8317 NP-6670

Canada. Dept. of Mines and Technical Surveys. Mines Branch.
THE VOLUMETRIC DETERMINATION OF THORIUM IN HIGH GRADE THORIUM PRODUCTS USING A SPECTROPHOTOMETRIC TITRATION. R. J. Guest. Dec. 17, 1957. 52p. (TR-148/57).

A procedure is described for determining thorium in high-grade thorium products by means of a spectrophotometric titration using ethylenediaminetetraacetic acid (EDTA) as the titrant and pyrocatechol violet as the indicator. Preliminary removal of interfering ions is carried out by means of an oxalate separation. A comparison of several possible separation procedures for removal of interfering ions is made and a number of factors which affect the nature of the spectrophotometric end point are discussed. The precision of the method has been determined for the titration procedure on standard solutions and for the entire procedure on typical samples. On products containing from 70 to 100% thorium, the standard deviation expressed as the percentage of the mean was found to be about 0.77%. This represents a 95% confidence level of approximately ± 0.5. (auth)

8318 ORNL-1088(Del.)

Oak Ridge National Lab., Tenn.
ANALYTICAL CHEMISTRY DIVISION QUARTERLY PROGRESS REPORT FOR PERIOD ENDING MARCH 26, 1951. Oct. 8, 1951. Decl. with deletions Feb. 20, 1957. 123p. Contract W-7405-eng-26. $19.80(ph OTS); $6.30 (mf OTS).

The automatic simultaneous semimicro titration of U and Fe with ceric sulfate has been effected satisfactorily at 60°C. Submicrogram quantities of U(VI) were isolated by filter paper partition chromatography using 2-methyltetrahydrofurane containing aqueous HNO_3 as the mobile liquid phase. The possibility of separating U(VI) from other cations by this technique is suggested. The use of radioautography and α-counting methods gave a highly sensitive method for locating solute sorption bands on the chromatograms. Use of the recording polarograph provided with the "curve follower" was extended to determine U(VI) at concentrations of 0.5 and 1.0 μg/ml in 0.1M HNO_3; trace quantities of Pb in blood, urine, and air; 0.02 and 0.04 μg/ml of In, a special technique being required to overcome difficulties in the potential region of the electrocapillary zero; and In in In–Th alloy. A special protective hood is illustrated which facilitates Pu titrations. Studies of Cr^{51} decay have shown very little β^- or e^-, and the presence of two γ rays of 0.33 and 0.27 Mev in the ratio 3 to 1. γ radiation was found to accompany 15% of the total disintegration, decay thus appearing to be 11.3% through the 0.33-Mev level, 3.8% through the 0.27-Mev level, and 85% directly to the ground state. A value for the half life of 27 ± 0.4 days was indicated. Decay studies on Sr^{85} indicated that the radiation was composed entirely of Rb x rays and γ radiation of 0.52 Mev. The activity due to conversion of electrons appeared to be of the order of 0.2%. The decay was 77% directly to the ground state and 23% accompanied by the 0.5-Mev γ ray. Two methods are suggested for the routine assay of low-level liquid wastes (10^{-3} to 10^{-5} μc/ml). Dishes of four designs have been studied to replace those in current routine use as sample mounts for gross β counts. A method for the separation of Am and Cm from the rare earths is being studied which consists in extracting them from an aqueous phase of pH 5 with 0.5M TTA-xylene and then "stripping" the organic phase with versene. The effect of pH on the selectivity of Am stripping is shown. A rapid method of removing deposited oxide layers or films from stainless steel was developed. The n-butyl bromide method has been found to be a suitable replacement for the Pepkowitz and Judd method for determining O in Na. Study of Dow Corning Silicone Oil 550 indicated instability at temperatures above 1200°F because of polymerization, even when not in contact with Na. A gravimetric perchlorate method was developed for determining K in the Na–K–U fluoride eutectic. The pyrohydrolysis method for the determination of fluoride in

ZrF_4, UF_4, ThF_4, HfF_4, and BeF_2 is recommended as an improvement over the Willard and Winter steam-distillation method. Fractional distillation of the chlorides of Ti, Nb, and Ta was investigated; the study of various chlorinating agents, resulting in the selection of heptachloropropane, is reported. $NbCl_5$ was almost quantitatively recovered in the higher boiling fraction. Analytical problems of the HRE are discussed. The ultraviolet spectrophotometric absorption method for the determination of phthalate ion in recycle liquors from the Zr refining process was shown to be sufficiently accurate for routine use. A sample of bonded graphite (Carbate) was bombarded with electrons. A microcombustion technique showed the bombardment to have effected a decrease in the H content. The synthesis of iodoacetylene is reported. (W.L.H.)

8319 ORNL-1276(Del.)
Oak Ridge National Lab., Tenn.
ANALYTICAL CHEMISTRY DIVISION QUARTERLY PROGRESS REPORT FOR PERIOD ENDING MARCH 26, 1952. Oct. 2, 1952. Decl. with deletions Feb. 20, 1957. 110p. Contract W-7405-eng-26. $16.80(ph OTS); $5.70 (mf OTS).

Progress is reported on the following projects: ionic analyses, radiochemical analyses, measurement of radioactivity, analysis of cyclotron products, solvent extraction methods, applications of ion exchange in radiochemical analysis, activation analyses, spectrochemical analyses, preparation of Al phosphide, optical and electron microscopy of metals and oxide films, determination of impurities in LiOH, replacement of SO_4^{-2} by Cl^- in alkali sulfates, electrodeposition of Bi on Al, analytical studies of fluoride eutectics, analysis of UO_2SO_4, determination of U by titration with chromous sulfate, preparation of RuOH, colorimetric determination of Ru, absorption spectra of UO_2SO_4, and determination of Cu and U(IV). (W.L.H.)

8320 ORNL-1423(Del.)
Oak Ridge National Lab., Tenn.
ANALYTICAL CHEMISTRY DIVISION QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 26, 1952. Mar. 4, 1953. Decl. with deletions Feb. 20, 1957. 66p. Contract W-7405-eng-26. $10.80(ph OTS); $3.90(mf OTS).

Progress is reported on the following studies: ionic analysis (derivative polarography, vibrating-reed electrometer, high-impedance preamplifier, polarographic determination of Pb and Zn in Th, conductivity bridge, vacuum-fusion analysis of C–Th alloys for O_2 and N_2, potentiometric microtitrator); radiochemical analysis (nuclear properties, radioactivity; Pu analysis by α counting, solvent extraction methods, carrying of Cu by fluoride precipitates); activation analysis (short-lived isotopes to be used in activation analysis, determination of trace amounts of U on filter paper, assay of aplite ore for trace elements); spectrochemical analysis; general analysis laboratory (fluoride in UO_2F_2 by ion-exchange and pyrohydrolysis separation methods, potentiometric titration of B); temperature correction factors for specific gravity of $UO_2(NO_3)_2$; automatic titration of U; analysis of alkali hydroxides; U determination in Bartow clays; analysis of UO_2SO_4 and UO_3; and analysis of ThO_2 slurries. (L.T.W.)

8321 ORNL-1474(Del.)
Oak Ridge National Lab., Tenn.
ANALYTICAL CHEMISTRY DIVISION QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JANUARY 10, 1953. Mar. 26, 1953. Decl. with deletions Feb. 21, 1957. 69p. Contract W-7405-eng-26. $10.80(ph OTS); $3.90 (mf OTS).

The development of ionic analytical methods included the paper-chromatographic separations of Pa^{233}, Zr^{95}, and Nb^{95} from Thorex process solutions. The chromatographic separation of U from other metals was studied with eight additional radionuclides. The derivative polarographic electrode system was applied to the determination of U and Fe in the same solution. Research on analytical instrumentation included additional developmental work on the automatically recording, internal-standard flame photometer; contrasting single-beam and double-beam operations are discussed. The gating circuit of the ORNL model Q-945 automatic titrator was revised to facilitate the setting of the diode-adjust potentiometer. The circuit of the ORNL model Q-963 curve-follower was revised to increase stability and sensitivity. Design problems encountered in the work on analytical applications of the ORNL Gridos h-f oscillator are discussed. A microelectrode assembly for the measurement of the pH of small volumes of highly radioactive solutions is described. Radiochemical research contributed some data on the decay scheme of Ce^{141}. Gamma rays of 0.83 and 1.06 Mev energies have been found in Cs^{136}. The neutron cross sections for the production of Sc^{48} and Sr^{85} was found to be 21.6 and 1.2 b. The cross section for the production of a long-lived Ti^{41} isomer is less than 10^{-6} b. Further work is reported on the determination of Pu by α counting and on the measurement of α emitters in radioisotope products. A method has been completed for determining the HRE flux by measurement of the Cs^{136} yield. Applications of radioactivation analysis to the determination of trace amounts of rare-earth elements in metals and animal tissue; of Co, Sr, and As in animal tissue; of Mo and U in soil, river mud, and water; and of Al in rubber are reported. Routine determinations of Na, Ba, U, and V in various materials are described. Spectrochemical procedures are described for the determination of rare earths in Th and stainless steel, of traces of B in graphite and Al, and of precious metals in native Fe. A procecure is reported for the preparation of $LaCl_3$ for use in studies of solid solutions of U trihalides in La halides. A solid solution of UF_3 in $LaCl_3$ was prepared. Metallic Cr was prepared from Cr_2O_3. Optical and electron microscopies were employed to show the nature of lamellar pearlite in the nodular structure of type B-23 steel. Procedures are described for the determination of nitrates in U oxides and uranyl sulfate and the ion-exchange separation of Ca and U and of U and Th. The possibility of a Pu quenching effect on the fluorometric determination of U is indicated. A solvent-extraction procedure for the removal of Zr and Nb from Pu in the analysis of Purex process samples is described. Methods were adapted for the identification and determination of impurities in the proposed ARE fuel eutectic. An indirect method for U determination has been developed based on the measurement of the ferrous-o-phenanthroline complex formed when U(VI) reduces Fe(III) in the presence of the complexing agent. The titration of high-molecular-weight amines in nonaqueous solvents has been shown to be a versatile, sensitive, and accurate method for their determination. Improved precision and sensitivity were obtained by use of Chrome Azurol S dye for the determination of traces of fluoride in uranyl sulfate solutions. Statistical analyses have been made of quality control data for 72 types of determinations. (J.E.D.)

8322 AEC-tr-3188
POLAROGRAPHY OF URANIUM. M. Shinagawa and T. Murata. Translated from Pararogurafi 5, 41-59(1957). 59p.

Various uranium waves are given for basic solutions, neutral solutions, weakly acidic solutions, and strongly acidic solutions. The disproportionation reaction of uranium is discussed. Uranium polarographs are given in

various supporting electrolytes. Other electrical analytical methods for the analysis of uranium in various media are given. (W.L.H.)

8323

SPECTROPHOTOMETRIC DETERMINATION OF RHODIUM AND PLATINUM IN PLUTONIUM. Maynard E. Smith (Los Alamos Scientific Lab., N. Mex.). Anal. Chem. 30, 912-13(1958) May.

The spectrophotometric method for the simultaneous determination of rhodium and platinum has been adapted for use with plutonium samples. No separation from plutonium is necessary but a correction must be applied for the absorbance of plutonium(III) at the wave lengths used to determine the rhodium and platinum. Alloy samples are readily dissolved in sealed glass tubes at elevated temperatures. The standard deviation for the simultaneous determination of rhodium and platinum in plutonium solutions in the range of about 5 to 14 ppm is approximately 2 relative %. (auth)

8324

PHOTONOMETRIC DETERMINATION OF VANADIUM AND CHROMIUM. Clark E. Bricker and Stephen S. Schonberg (Princeton Univ., N. J.). Anal. Chem. 30, 922-8(1958) May.

The number of photons or the time of exposure to a mercury vapor lamp is measured for determining chromium(VI) and/or vanadium(V). The photochemically sensitive solution of iron(III) and oxalic acid containing the chromium and/or vanadium is exposed to measured increments of radiation and the formation of chromium(III) or vanadium(IV) is followed photometrically. Because the quantum efficiency of these reductions remains essentially constant over a rather wide range of experimental conditions, the radiation from the lamp can be considered to generate a titrant at a constant rate. The rate at which the titrant is formed is determined by calibrating the lamp with known amounts of chromium or vanadium. The effect of a number of variables on this reaction has been determined. (auth)

8325

VOLUMETRIC DETERMINATION OF ALUMINUM IN PRESENCE OF IRON, TITANIUM, CALCIUM, SILICON, AND OTHER IMPURITIES. H. L. Watts (Aluminum Co. of America, East St. Louis, Ill.). Anal. Chem. 30, 967-70 (1958) May.

In highly basic solution, aluminum forms soluble sodium aluminate, and iron and titanium precipitate as hydroxides. When aluminum reacts with fluoride, the hydroxide which combines with the aluminum can be released for titration with standard acid. The titration can be performed in the presence of the precipitated hydroxides. Interference from calcium can be eliminated by precipitating it as the oxalate. By limiting the sample size, aluminum can be determined in the presence of silicon dioxide. The method is fast, precise, and accurate. (auth)

8326

SEPARATION AND SPECTROPHOTOMETRIC DETERMINATION OF MICROGRAM AMOUNTS OF NIOBIUM. Glenn R. Waterbury and Clark E. Bricker (Los Alamos Scientific Lab., N. Mex.). Anal. Chem. 30, 1007-9(1958) May.

Niobium in amounts between 25 and 1000 γ can be extracted into hexone (4-methyl-2-pentanone) from a 6.3M sulfuric–1.6M hydrofluoric acid medium and estimated colorimetrically using hydroquinone in concentrated sulfuric acid. An average niobium recovery of 99.9%, with a standard deviation of 2.0%, was obtained for 38 analyses of solutions containing known amounts of niobium and various other metals. Of 31 metallic ions tested only tantalum and large amounts of molybdenum interfered seriously with the method. (auth)

8327

A METHOD FOR DETERMINING ^{24}Na AND ^{42}K WHEN PRESENT TOGETHER IN LIQUID SAMPLES. M. P. Esnouf (Univ. of Oxford). Brit. J. Appl. Phys. 9, 161-2(1958) Apr.

A simple method has been described for the separate determination of Na^{24} and K^{42} in liquid samples, which is based on the differential absorption of β particles. The relative concentrations of the isotopes are estimated from the difference in the observed counting rates of a sample when it is measured in a type M6 tube and in a modified M6 tube. Details are given for the necessary modification of the M6 tube. (auth)

8328

DETERMINATION OF GROSS BETA ACTIVITY IN URINE WITH K-40 CORRECTION. E. R. Ebersole and J. K. Flygare, Jr. (U. S. Atomic Energy Commission, Idaho Falls, Idaho). Proc. Health Phys. Soc. 72-8(1957).

A method is given for the determination of the gross beta activity in urine. The method is based on the removal of organic material and correction of K^{40} activity based on actual potassium content of the sample. (J.S.R.)

Deuterium and Deuterium Compounds

8329 NBS-5446

National Bureau of Standards, Washington, D. C.

A REVIEW OF THE PROPERTIES OF DEUTERIUM AND TRITIUM COMPOUNDS. Annual Bibliography—1955. Virginia R. Johnson. Oct. 30, 1957. 89p. NBS Project No. 0302-11-2641. $13.80(ph OTS); $4.80(mf OTS).

The references in the bibliography are arranged alphabetically according to the last name of the leading author. Each reference is numbered by a letter-number symbol, corresponding, respectively, to the first letter of the leading author's last name and the numerical listing under that letter. The names of co-authors are listed alphabetically and cross-indexed. Compound and subject indexes are included for the convenience of the reader. This bibliography contains 455 references to published research on deuterium and tritium compounds and was compiled entirely from volume 49 (1955) of Chemical Abstracts. Research articles related to nuclear properties have been excluded, except where other pertinent information on deuterium or tritium was reported. Also the topic of Isotope Effects has been restricted primarily to the isotopes of hydrogen, whereas the topic of Isotope Separation still contains references to works on the separation of isotopes of various elements. (auth)

8330

PREPARATION AND PROPERTIES OF SOME ALKYLSILANEDEUTERIDES. V. A. Ponomarenko, Yu. P. Egorov, and G. Ya. Vzenkova (Zelinskii Inst. of Organic Chemistry, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R. Otdel. Khim. Nauk, No. 1, 54-8(1958) Jan. (In Russian)

It is shown that some alkylsilanedeuterides can be obtained from corresponding alkylsilanechlorides that were reacted with LiD. Five new alkylsilanedeuterides were prepared and their physical properties studied. The Si–D valence bond oscillation frequencies were found within the region 1530 to 1570 cm^{-1}; the frequencies reduced with the number of deuterium atoms substituted on silicon. The bond refraction of Si–D is 3.23 ml/mole. (tr-auth)

8331

ON THE STRUCTURE DIAGRAM OF THE HYDROGEN–DEUTERIUM SYSTEM. V. S. Kogan, B. G. Lazarev, and

R. F. Bulatova (Inst. of Physics in Tech., Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz. 34, 238-40(1958) Jan. (In Russian)

Fluorine and Fluorine Compounds

Refer also to abstract 8374.

8332 UCRL-3894

California. Univ., Berkeley. Radiation Lab.

THE REACTIONS OF MIXED CRYSTALS OF RARE EARTH FLUORIDES WITH FLUORINE GAS (thesis). William P. Bryan. Aug. 1957. 65p. Contract W-7405-eng-48. $10.80(ph OTS); $3.90(mf OTS).

The reactions of mixed crystals of rare earth fluorides with fluorine gas have been studied gravimetrically by determining the weight increases of mixed trifluoride samples upon exposure to fluorine at a pressure of 1 atmosphere and a temperature of 250°C. A special nickel helix balance was developed for directly studying these weight changes in an atmosphere of fluorine. The nature of the phases produced upon fluorination was studied by x-ray-diffraction methods. The following cerium-containing mixed trifluoride systems were studied over the whole range of compositions: CeF_3-LaF_3, CeF_3-YF_3, and CeF_3-PrF_3. In all these systems the cerium is completely oxidized to the +4 state, and in a restricted range of the CeF_3-PrF_3 system some of the praseodymium is oxidized to the +4 state. The following terbium-containing mixed trifluoride systems were studied over the whole range of compositions: TbF_3-LaF_3 and TbF_3-YF_3. In neither case does complete oxidation of terbium to the +4 state occur after certain amounts of LaF_3 or YF_3 have been added to the TbF_3. The above results are explained thermodynamically and the $\Delta F°$ value for the reaction $TbF_3 + \frac{1}{2} F_2 = TbF_4$ is estimated as being in the range between −278 calories and 0 calories at 250°C. (auth)

Graphite

Refer also to abstract 8498.

8333 NP-6615

Buffalo. Univ.

PROGRESS REPORT NO. 3 [FOR] DECEMBER 1, 1957 TO FEBRUARY 28, 1958. J. F. Andrew, J. Repetski, H. E. Strauss, D. C. Wobschall, and S. Mrozowski. Mar. 1, 1958. 9p. Contract AF33(616)-5186.

The graphitizing furnace and the elasticity apparatus were finished for use in studies on the elastic properties of carbons and graphites at room temperature in relation to some fabrication variables and the heat conduction of graphite at high temperature. A large number of different samples of the type soft filler-soft binder were extruded, baked, and graphitized. Their densities and coke structure densities are being determined. Other test specimens are reported to be in process of preparation. (For preceding period see NP-6514.) (C.H.)

8334 WADC-TR-57-602

National Carbon Co. Research Labs., Cleveland.

GRAPHITE-BASED MATERIALS FOR HIGH TEMPERATURE APPLICATIONS. Period covered: 12 month period through July 31, 1957. M. Janes. Dec. 2, 1957. 65p. Project No. 2998. Contract AF33(616)-3537. (AD-150962).

Recent aerodynamic developments require a material which will endure under conditions of high heat flux with consequent high surface temperatures and high flow of an oxidizing gas relative to a body of the material. Surface temperature rise may be quite rapid, so that the material must possess resistance to thermal shock. Graphite has outstanding high temperature strength, a high sublimation temperature, and excellent thermal shock resistance in comparison to other agglomerate bodies. However, it is quite reactive with oxygen or other oxidizing gas at high temperatures and high relative gas flow rates. The results of a first year of a program to compare the oxidation, with accompanying erosion, of graphite prepared with variation in raw materials or processing, and of combinations of graphite with metals, carbides and compounds such as calcium fluoride are summarized. Three different procedures for testing oxidation-erosion resistance, varying in principle and in severity, were developed and used. Two procedures for evaluating relative thermal shock resistance are described. Graphite materials prepared by the variations in raw materials and processing so far evaluated, show relatively minor differences in oxidation-erosion rate. Removal of catalytic impurities substantially reduces the rate of oxidation if any portion of the specimen is subjected to relatively low temperature oxidation. Combinations of graphite with various carbides such as those of boron and titanium together with silicon carbide, with the carbide incorporated throughout the body, have shown considerably improved oxidation resistance in an intermediate temperature range (to about 1700°C). It appears possible that further development will extend the stability of these materials to higher temperatures. (auth)

8335 NP-tr-66

THE ALKALI–GRAPHITE COMPOUNDS. W. Rüdorff and E. Schulze. Translated by S. Asher from Z. anorg. u allgem. Chem. 277, 156-71(1954). 12p.

By thermal decomposition of C_8K and also by reaction of graphite with potassium and rubidium, further alkali–graphite compounds can be obtained which have alkali layers in only every third, fourth, or fifth layer space parallel to the base in the graphite lattice. The composition of Step 2—which previously had the formula $C_{16}Me$—corresponds to $C_{24}Me$, and the ideal formulas for the subsequent steps are $C_{36}Me$, $C_{48}Me$, and $C_{60}Me$. At all stages the carbon layers next to the alkali layers have identical positions above one another while the other carbon planes are oriented together as in graphite. For the first step, C_8Me, a new structural model was developed. Magnetic measurements give a weak paramagnetism for Steps 1 to 5. (auth)

8336

ENERGY EXCHANGE BETWEEN COLD GAS MOLECULES AND A HOT GRAPHITE SURFACE. Lothar Meyer and Robert Gomer (Univ. of Chicago). J. Chem. Phys. 28, 617-22(1958) Apr.

Methane or ethane do not decompose on clean graphite surfaces up to 2300°C as long as the mean free path of the gas molecules exceeds the dimensions of the reaction cell. An investigation of the energy exchange between a hot graphite surface and cold molecules impinging on it revealed an accommodation mechanism of temporary adsorption followed by evaporation at critical temperatures essentially independent of the filament temperature as long as the latter is higher than the former. The evaporation temperature for methane is far below its decomposition temperature. (auth)

8337

PLASTICITY OF GRAPHITE. H. W. Davidson and H. H. W. Losty (General Electric Co., Ltd., Wembley, Middlesex, Eng.). Nature 181, 1057-9(1958) Apr. 12.

The creep behavior of graphite in the temperature range

1,300 to 2,000°C was investigated. The experiments were carried out by applying loads to cantilevers heated in vacuo by the passage of an electric current and to spring specimens heated in a high-temperature high-vacuum furnace. It was found that for a wide range of temperatures, raw materials, specimen geometries, and flexual and torsional stresses, the creep deformation could be statistically fitted within the limits of experimental error to the function $D_t = A + k\log_{10}t + Bt$ where D_t is strain at stress time t and t is time (min.). A, k, and B are constants for each experiment. The creep recovery on removing the load conformed to the function $D_t^1 + A^1 + k^1 \log t$. (J.S.R.)

Laboratories and Equipment

8338 ISC-860
Ames Lab., Ames, Iowa.
EXTRACTION EFFICIENCY OF A PULSE COLUMN OF VARIED GEOMETRY. Lawrence E. Burkhart and R. W. Fahien. June 1956. 48p. Contract W-7405-eng-82. $1.25(OTS).

An investigation was made of the effects of plate spacing, hole diameter, percent free plate area, pulse amplitude, and pulse frequency on the extraction efficiency of a 1-in. diameter pulse column. The hexone–acetic acid–water system was used. Two levels of each factor were incorporated in an experimental design based on statistical methods. The diameter of the holes in the perforated plates of a pulse column produced the greatest effect on extraction efficiency of the factors studied. Percent free area produced only a small effect which was dependent on the degree of pulsation applied to the column. Extraction efficiency varied inversely with pulse amplitude and pulse frequency. The recycle or back mixing, which exists in the pulse column was postulated to have a profound effect upon extraction efficiency. (auth)

8339 NP-tr-68
HYDROGEN LIQUEFIER FOR RESEARCH INSTITUTES. M. P. Malkov and A. B. Fradkov. Translated by R. C. Murray from Zhur. Tekh. Fiz. 22, 436-45(1952). 16p.

The design for a prototype for a series production hydrogen liquefier is discussed. The method of liquefaction, the method of insulating the low temperature apparatus, and the method of purifying the initial electrolytic hydrogen are presented. Compressed hydrogen is cooled consecutively in the heat exchanger I, in the liquid nitrogen bath II, and in the main heat exchanger III. After cooling in III, the hydrogen undergoes free expansion, and from it is withdrawn, at the low temperature, the refrigerating capacity of the cycle. The considerations which led to the choice of this design are included. (M.H.R.)

Molecular Structure

8340 ISC-746
Ames Lab., Ames, Iowa.
THE (C-H) BOND DISSOCIATION ENERGY IN THE METHYL GROUP OF TOLUENE. Joseph Ignatius Genco, F. R. Duke, M. Griffel, and L. D. Jennings. Mar. 1956. 37p. Contract W-7405-eng-82. $0.30(OTS).

A kinetic study of the pyrolysis of toluene by a flow technique has been made, and assuming Szwarc's mechanism, two activation energies (78.3 and 84 kcal/mole depending on the temperature range used) have been derived for the dissociation of the (C-H) bond in the methyl group of toluene. The lower value agrees quite well with Szwarc's, and the higher value turns out to be approximately the average of 77.5 and 89.9. The results of this research suggest 84 kcal/mole as the upper limit for the activation energy. The ultraviolet spectra of the solid decomposition product indicated that the solid was not pure dibenzyl but probably contained small amounts of a compound possessing a diphenyl nucleus. The rate of formation of hydrogen and methane was found to be inhibited by small amounts of air, and the percentage of hydrogen was found to increase slightly with temperature. A detailed description of the apparatus and its operation is given. The concept of group potential has been introduced to predict bond dissociation energies of carbon-hetero atom and carbon-carbon bonds. (auth)

Radiation Chemistry

8341 ISC-855
Ames Lab., Ames, Iowa.
CHEMICAL EFFECTS OF PHOTONUCLEAR REACTIONS IN THE PROPYL BROMIDES. A. E. Richardson and A. F. Voigt. Dec. 1956. 86p. Contract W-7405-eng-82. $2.25(OTS).

When nuclear reactions occur in atoms in molecules chemical changes follow as a result of the recoil of the product atoms. The nature of these chemical changes was studied intensively for a number of systems but in most cases the magnitude of the recoil energy was about the same. In the present studies use was made of a much greater recoil energy than that normally used. The reaction $Br(\gamma,n)Br^*$ gives a recoil bromine atom with an energy of the order of 10^5 ev, compared to 10^2 ev for the product of the $Br(n,\gamma)Br^*$ reaction which is usually used. The chemical nature of the products resulting when the propyl bromides were irradiated with neutrons and 70-Mev gamma rays was studied by established techniques. It is possible to differentiate between the reactions which occur while the recoiling bromine atom still is highly energetic, or "hot," and those which occur after it has been slowed down to thermal energies. The products of the hot reactions show little dependence on the initial recoil energy. In the case of the thermal reactions, the higher energy recoil produces a greater number of products which are different from the original molecules. This can be attributed to the presence of a higher concentration of free radical fragments which are produced in slowing down the higher energy recoiling atom. These fragments combine with the radioactive bromine after it has reached thermal energies to form a greater variety and amount of new products. (auth)

8342
RADIATION AND OIL CRACKING. M. F. Hoare (Esso Research, Ltd.). New Scientist 3, No. 71, 28-30(1958) Mar. 27.

A very brief survey is made of the possibility of using radiation to obtain greater flexibility in refining operations. As yet the available data on radiation effects on hydrocarbons is insufficient to make an accurate forecast of the exact role that radiation will play in the petroleum industry, although the oil industry is investigating the possible application of high-energy radiation to oil processing. (J.S.R.)

8343
GRAFT COPOLYMERS—A NEW TECHNOLOGY. Donald J. Metz (Brookhaven National Lab., Upton, N. Y.). Nucleonics 16, No. 4, 73-7(1958) Apr.

Radiation production of special plastics may be the basis of a new technology. Changes induced in organic polymers by radiation are generally interpreted in terms of free-radical mechanisms. Methods of grafting with radiation

are described. Dielectric properties, tensile strength, and water repellant properties are a few characteristics which may be improved by a grafting technique. (J.S.R.)

8344

ON CERTAIN REACTION-MECHANISMS OF HOT ATOMS. I. G. Campbell (Inst. of Nuclear Research, Warsaw). Nukleonika 3, 43-52(1958). (In Polish)

An account is given of some important features of hot atom reactions with atoms and molecules of the environment. An analysis is made of Libby's billiard ball hypothesis, and other theories of chemical bonds by hot, epithermal, and cooled atoms are outlined. (tr-auth)

Radiation Effects

Refer also to abstract 8421.

8345 HW-54994

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

IRRADIATION OF THE BIPHENYL, ORTHO-, META-TERPHENYL EUTECTIC. D. R. de Halas. Feb. 17, 1958. 14p. Contract W-31-109-Eng-52. $0.50(OTS).

The ternary eutectic of 55 per cent ortho-, 20 per cent meta-terphenyl and 25 per cent biphenyl has been irradiated in an in-reactor facility. Some of the physical property changes during irradiation have been measured. The stability of the two terphenyls and the biphenyl towards radiolytic damage are about equal, and only slightly greater than that measured for monoisopropylbiphenyl in previous experiments. (auth)

8346 NARF-58-10T

Convair, Fort Worth, Tex.

RADIATION EFFECTS ON ORGANO-SILICONS. T. W. Albrecht. Feb. 25, 1958. 52p. Project 6(1-9964). Contract AF33(600)-32054. (MR-N-190).

A discussion of the heat, radiation, and oxidative stability of silicon materials. A study is made of the comparative stability of silicon with organic molecules through the use of electronegativity and bond strength differences of the elements and the rate of diffusion of the free radicals away from their bond rupture site. A stepwise energy reduction mechanism for oxygen is proposed that allows molecular oxygen to be changed to atomic oxygen in small 30 to 40 kcal increments rather than in one big step of 96 kcal. The mechanism helps explain the relative ease of oxidation of silicon materials and the products formed at relatively low temperatures. Theories of antioxidants as a means of protecting irradiated silicon materials are discussed briefly. (auth)

Rare Earths and Rare-earth Compounds

Refer also to abstracts 8332 and 8364.

8347 AECU-3662

Illinois. Univ., Urbana. Noyes Lab. of Chemistry.

BEHAVIOR OF POLYVALENT METALLIC IONS IN 100% ACETIC ACID; REACTIONS OF RARE EARTH COMPOUNDS IN ACETIC ACID. Final Report. L. F. Audrieth, J. A. Seaton, and F. G. Sherif. Oct. 31, 1957. 73p. Project No. 18. Contract AT(11-1)-67. $13.80(ph OTS); $4.80(mf OTS).

The solution of a polymeric oxide such as a rare earth oxide in protonic solvents such as acetic acid may be regarded as a step-wise process involving rupture of Ln-O-Ln linkages, to form "hydroxyacetates" of varying molecular size and complexity. Intermediate oxo- and hydroxo- bridged aggregates could therefore be formed by solvolytic processes. Further reaction with acetic acid (in the presence of acetic anhydride) could effect dehydration of such "hydroxyacetates," to yield oxo-bridged basic acetates, $Ln_2O(OAc)_4 \cdot 2HOAc$. Such basic acetates may also be obtained when either the hydrated rare earth hydroxides or nitrates are allowed to react with acetic anhydride. It is believed that previous attempts to prepare "anhydrous" rare earth acetates have yielded only such basic acetates. Rare earth oxides react with acetic anhydride to form anhydrous rare earth acetates, which differ in x-ray-diffraction patterns, solubilities, chemical reactions, and infrared absorption from the basic acetates. Long refluxing of the basic acetates in acetic anhydride results in conversion to the anhydrous acetates. Rare earth oxide-acetic acid solutions, as well as solutions of rare earth acetates in acetic acid were titrated conductometrically with various acids. The reactions which appear to take place are listed: $Ln_2(OH)_2(OAc)_4 + 6HClO_4 \rightarrow 2Ln(ClO_4)_3 + 4HOAc + 2H_2O$; $Ln(OAc)_3 + 3HClO_4 \rightarrow Ln(ClO_4)_3 + 3HOAc$; $Ln_2(OH)_2(OAc)_4 + 2H_2B \rightarrow Ln_2(OH)_2(B)_2 \cdot 2HOAc + 2HOAc$; and $Ln(OAc)_3 + H_2B \rightarrow Ln(OAc)(B) \cdot HOAc + HOAc$, where $B = SO_4^=$, $C_2O_4^=$, $HCit^=$ (with two additional moles of solvated acetic acid). Treatment of neodymium oxide-acetic acid solutions with phosphoric acid yielded a material of variable composition. The visible and ultraviolet absorption spectra of neodymium acetate in water and in acetic acid were found to be similar with slightly smaller molar absorptivities in the acetic acid solutions. Neodymium acetate shows amphoteric properties in that its solubility in acetic acid is increased as the concentration of potassium acetate becomes greater. Transference experiments suggest the existence of anionic neodymium species in such solutions. Anhydrous neodymium chloride was found to be soluble to the extent of 12.3 gm per 100 gm of anhydrous acetic acid. Partial solvolysis with the elimination of hydrogen chloride occurs when such solutions are refluxed. Yttrium oxide does not dissolve in, or react with, either anhydrous acetic acid or acetic anhydride. However, hydrated yttrium hydroxide forms a basic acetate upon treatment with acetic anhydride. (auth)

8348 ISC-831

Ames Lab., Ames, Iowa.

THERMAL EXPANSION OF RARE EARTH METALS. Fred Barson, S. Legvold, and F. H. Spedding. June 1956. 77p. Contract W-7405-eng-82. $2.00(OTS).

A high-temperature dilatometric investigation of the rare-earth metals was undertaken as part of a broad program of study of these elements, the ultimate goal being better understanding of metals in general. The more immediate goal, in addition to determining the coefficients of expansion quantitatively, was to detect evidence of any crystalline transformations which may occur and particularly to cast some light on certain high-temperature transitions already discovered in several of these metals. The rare-earth metals included in this investigation were lanthanum, cerium, praseodymium, neodymium, gadolinium, terbium, dysprosium, erbium, and ytterbium. (auth)

8349

EXTRACTION AND PURIFICATION ON AN INDUSTRIAL SCALE OF SAMARIUM AND EUROPIUM. Ch. de Rohden. Energie nucléaire 2, 21-8(1958) Jan.-Mar. (In French)

Samarium and europium both have a high neutron absorption cross section, which suggests their utilization for reactor control. Two apparatuses for continuous or semi-continuous production are described, one of which will produce 1 kg of samarium oxide and the other will

produce 100 g of europium oxide. Both oxides have a purity of more than 99%. The apparatus can be enlarged or even doubled if the demand for the metals justifies it. (tr-auth)

Separation Procedures

8350 BC-43(Del.)
California. Univ., Berkeley. Radiation Lab.
THE RECOVERY OF C^{14} FROM IRRADIATED BERYLLIUM NITRIDE. B. A. Fries. Mar. 7, 1947. Decl. with deletions Feb. 13, 1957. 11p. Contract W-7405-eng-48. $3.30(ph OTS); $2.40(mf OTS).

Both acid and alkaline dissolutions of Be_3N_2 were carried out. The two methods are discussed and results given. The recommended alkaline dissolution procedure is outlined. (M.H.R.)

8351 BLG-13
Brussels. Centre d'Etude de l'Énergie Nucléaire.
TREATMENT OF RADIOACTIVE EFFLUENTS WITH SAWDUST OR BROWN-COAL. P. Dejonghe, N. Van de Voorde, and M. D'hont. Dec. 4, 1957. 24p.

Sawdust, rotted sawdust, and brown-coal can be used for radioactive effluent treatment. Generally the volume of rotted material consumed is less than 1% of the volume of treated water at a removal of more than 95% of the radioactivity. In most cases this adsorption should be preceded by a chemical precipitation in order to remove bi- and trivalent chemical impurities. (auth)

8352 BLG-15
Brussels. Centre d'Etude de l'Énergie Nucléaire.
PREPARATION DU SOUFRE 35 SANS PORTEUR ET DU CHLORE 36. (Preparation of Carrier-Free Sulfur-35 and Chlorine-36). R. Constant. Jan. 6, 1958. 14p.

The irradiation of potassium chloride with thermal neutrons results in the radioisotopes K^{40}, K^{42}, Cl^{36}, Cl^{38}, and S^{35}. K^{42} and Cl^{38} have such a short half life that the problem is reduced to the separation of K^{40}, Cl^{36}, and S^{35}. The potassium is fixed on a cation exchange resin saturated with hydrogen. The eluent then is a solution of HCl containing Cl^{36} and S^{35}, in the form of SO_4^{2-}. The hydrochloric acid–sulfuric acid separation is made by distillation. Regeneration of the resin by HCl leads to the recovery of the potassium enriched with K^{40}. (J.S.R.)

8353 BMI-99
Battelle Memorial Inst., Columbus, Ohio.
CHEMICAL PROCESS TO RECOVER URANIUM FROM PHOSPHATE ROCK. Iver Igelsrud. Nov. 15, 1947. Decl. Mar. 5, 1956. 45p. Contract W-38-094-eng-27. $7.80 (ph OTS); $3.30(mf OTS).

A summary is presented of research done on dissolving uranium from phosphate rock and superphosphate and recovering uranium from the solution in a more concentrated form. Research on the recovery of P_2O_5 from leach solutions is also included. (W.L.H.)

8354 DOW-36
Dow Chemical Co. Great Western Div., Pittsburg, Calif.
PRESENT STATUS OF ION EXCHANGE PROCESS FOR URANIUM RECOVERY. W. Hirschkind and R. H. Bailes. Sept. 30, 1950. Decl. Apr. 21, 1958. 34p. Contract AT-30-1-GEN-236. $9.30(ph OTS); $3.60(mf OTS).

A description of the ion exchange pilot plant for the recovery of U and V from industrial 30% H_3PO_4 is given. The plant was designed to process 1000 gallons per day of 30% H_2PO_4 for U and V recovery. Three 10 in. columns operated step-wise and countercurrently are used. Elution of V is accomplished with aqueous SO_2, and of U with 1M NaCl. Nearly complete automatic control is obtained through a sequence timer and a number of pneumatic automatic control valves. (W.L.H.)

8355 DOW-40
Dow Chemical Co. Great Western Div., Pittsburg, Calif.
URANIUM RECOVERY FROM MISCELLANEOUS MATERIALS. Progress Report [for] December 1950. R. H. Bailes. Dec. 29, 1950. Decl. Mar. 17, 1958. 50p. Contract AT-30-1-GEN-236. $7.80(ph OTS); $3.30(mf OTS).

Studies on the application of ion exchange to the recovery of U and V from various leach liquors are reported. Research is reported on the use of ion exchange resins to purify U products. (auth)

8356 DOW-58 and DOW-60
Dow Chemical Co. Western Div., Pittsburg, Calif.
THE RECOVERY OF URANIUM FROM INDUSTRIAL PHOSPHORIC ACID. Progress Reports [for] July, August 1951. Research Dept. R. H. Bailes. (DOW-58, Aug. 3, 80p. and DOW-60, Aug. 5. 84p.) Changed from OFFICIAL USE ONLY Mar. 14, 1958. Contract AT-30-1-GEN-236. (DOW-58, $12.30(ph OTS); $4.50(mf OTS) and DOW-60, $13.80(ph OTS); $4.80(mf OTS).)

These two reports were issued separately, but are cataloged as a unit.

The use of alkyl acid phosphates in hydrocarbon diluents for the solvent extraction of uranium from industrial phosphoric acids and solid phosphatic materials is described. Experiments on the chemistry and mechanics of the solvent extraction process have been performed. Investigation of the ion exchange process for the recovery of uranium from industrial phosphoric acids has been continued. The effect of chloride and nitrate, and the properties of new ion exchange resins are detailed. Precipitation processes involving ammonia or sodium carbonate have been studied and the effect of certain variables on the recovery of uranium from industrial phosphoric acids by these methods is reported. (auth)

8357 DOW-59
Dow Chemical Co. Western Div., Pittsburg, Calif.
RECOVERY OF URANIUM BY ION EXCHANGE FROM AN ACID LEACH OF MARYSVALE ORE. D. A. Ellis. Aug. 16, 1951. Changed from OFFICIAL USE ONLY Mar. 14, 1957. 16p. Contract AT-30-1-GEN-236. $3.30(ph OTS); $2.40(mf OTS).

A sample of an H_2SO_4 leach liquor prepared from ore from Marysvale, Utah, was tested to determine the feasibility of U recovery by ion exchange. After preliminary tests on Ionac A-300, Amberlite IRA-400, and IR4B, Dowex-1 was selected for further study. The equilibrium isotherm for exchange of U between the leach liquor and fine-mesh Dowex-1 and graphs of column adsorption and elution with 1M NaCl, 1M NaCl + HCl, and 1M NH_4Cl + HCl are presented. Effects on column performance of degree of resin cross-linkage, temperature, number of cycles, and column length are discussed, and reagent consumption is estimated. (W.L.H.)

8358 DOW-70
Dow Chemical Co. Western Div., Pittsburg, Calif.
RECOVERY OF URANIUM BY AN ION-EXCHANGE PILOT PLANT FROM CONCENTRATED PHOSPHORIC ACID (29% P_2O_5). Summary Status Report. D. E. Garrett and G. R. Moore. Mar. 1, 1952. Changed from OFFICIAL USE ONLY Mar. 14, 1958. 69p. Contract AT-30-1-GEN-236. $10.80(ph OTS); $3.90(mf OTS).

An ion-exchange pilot-plant investigation of the recovery of uranium from industrial phosphoric acid is reported. This acid was more concentrated (29% P_2O_5) than that processed previously in this pilot plant. The effect of various factors on adsorption and elution from the resin

are described. Some of these factors are temperature, flow rate, reagent concentrations, and method and time of column advancement. A section on resin life and column operation is given, as is one on predictions of other column operation based on calculated adsorption data. (auth)

8359 DOW-71
Dow Chemical Co. Western Div., Pittsburg, Calif.
OPERATION OF U.S. PHOSPHORIC PRODUCTS EIGHT-FOOT DIAMETER ION-EXCHANGE COLUMN FOR THE RECOVERY OF URANIUM. D. E. Garrett. Jan. 30, 1952. Decl. Apr. 21, 1958. 48p. Contract AT-30-1-GEN-236. $9.30(ph OTS); $3.60(mf OTS).

Performance of the 8-ft-diam. ion-exchange column is presented. Physical operation of the column using fine-mesh resin was shown to be quite feasible. From the chemical point of view, the operation was not satisfactory. The U recovery was much lower than expected, being only about 40% for an acid diluted to 27% P_2O_5, and 55% for a 23% acid. The cost per pound of U from the ion-exchange process as developed to this point would be high. (W.L.H.)

8360 GAT-DM-673
Goodyear Atomic Corp., Portsmouth, Ohio.
IBM-650 PROGRAM FOR THE MATHEMATICAL MODEL OF A MULTICOMPONENT CASCADE. Denver L. Thomas. Mar. 24, 1958. 7p. Contract [AT(33-2)-1]. $1.80(ph OTS); $1.80(mf OTS).

A program has been written for the IBM-650 electronic computer to compute the performance of a three-component gaseous diffusion cascade. The assays are evaluated section-wise from the top of the cascade downward to the point where feed material is introduced into the cascade, and then from the bottom of the cascade upward to this feed point. An interpolation scheme has been built into this procedure so that the concentration of U^{235} at the bottom of the enricher portion of the cascade will match the specified assay of the feed materials to seven decimal places. By results obtained from this computer program, the behavior of U^{234} or U^{236} can be predicted, and the effects of the separation of U^{235} from the other components in the cascade system can be seen. (auth)

8361 GAT-L-197
Goodyear Atomic Corp., Portsmouth, Ohio.
PURIFICATION AND CONCENTRATION OF URANIUM IN RIVER WATER USING AN ION EXCHANGE RESIN. R. E. Shoaf, H. L. Galloway, and F. S. Voss. May 18, 1956. 6p. Contract AT(33-2)-1. $1.80(ph OTS); $1.80(mf OTS).

An analytical method is presented for the determination of uranium in river water containing a high solid content. The uranium is concentrated and purified by adsorption of the uranyl sulfate ion on an anion exchange resin, followed by elution with a small amount of nitric acid solution. The purified uranium is then determined fluorimetrically. This method was used for the determination of 0.000 to 0.005 mg of uranium per liter in river waters containing 400 to 1,000 mg per liter of dissolved solids. (auth)

8362 HEC-86
Hooker Electrochemical Co., Niagara Falls, N. Y.
RECOVERY OF POTASSIUM FLUOBORATE FROM SPENT ELECTROLYTE. George T. Miller. Mar. 31, 1958. 7p. Contract AT(30-1)-1524. $1.80(ph OTS); $1.80(mf OTS).

The electrolytic reduction of elemental boron enriched in the B^{10} resulted in a waste product. The waste product, spent electrolyte, contained potassium fluoride, potassium chloride, and potassium fluoborate. By recrystallization from a hot 25% aqueous solution of the spent electrolyte, > 98% pure potassium fluoborate was reclaimed. The yield was > 70% of theoretical. (auth)

8363 ISC-182(Del.)
Ames Lab., Ames, Iowa.
LIQUID-LIQUID EXTRACTION OF HAFNIUM FROM ZIRCONIUM BY TRIBUTYL PHOSPHATE. G. H. Beyer and H. C. Peterson. Dec. 3, 1951. Decl. with deletions Sept. 22, 1955. 14p. Contract W-7405-eng-82. (M-5742). $3.30(ph OTS); $2.40(mf OTS).

The removal of hafnium from zirconium is one of a number of operations required to produce high purity zirconium metal for use in nuclear reactors. Since the metallurgical operations involved in the production of zirconium must use the products of hafnium-removal processes, the choice of a process for hafnium removal must be integrated with subsequent metallurgical operations. The tributyl phosphate liquid-liquid extraction process removes hafnium from aqueous solutions of zirconium tetrachloride, yielding as final product recrystallized zirconyl chloride octahydrate containing less than 100 ppm of hafnium. If this extraction process, producing pure zirconyl chloride, were supplemented with an adequate metallurgical process for reduction to the metal, it might be possible to obtain zirconium more economically than by the conventional Kroll reduction. The results of separatory-funnel experiments, contacting equal volumes of solvent and aqueous zirconium phases, showed appreciable separation of hafnium from zirconium at various concentrations of acid and salting-out agent. With concentrations which gave encouraging separation in batch experiments, three continuous, countercurrent extractions were made in a 7-stage mixer-settler apparatus which produced hafnium-free zirconium as extract and 80% hafnium as raffinate. An analysis of the lesser elements associated with the zirconium at various stages in the process indicates that extraction with tributyl phosphate, followed by a recrystallization of zirconyl chloride, should be capable of producing material meeting AEC specifications. (auth)

8364 ISC-695
Ames Lab., Ames, Iowa.
SEPARATIONS OF YTTRIUM AND SOME RARE EARTHS BY LIQUID-LIQUID EXTRACTION. Raymond A. Foos and H. A. Wilhelm. July 1954. 77p. Contract [W-7405-eng-82]. $0.50(OTS).

The use of liquid-liquid extraction for the separation of some inorganic compounds was demonstrated. The yttrium–rare earth concentrates were obtained from Fergusonite ore, Gadolinite ore, and a by-product from an ion-exchange resin separation process. In each case the mixture in terms of oxide was composed of from 50 to 60% yttrium and 5 to 15% heavy rare earths with the light rare earth fraction constituting the remaining material. Tributyl phosphate was generally employed for extracting nitric acid solutions of these concentrates. Single-stage extractions indicated that the relative extractability of certain rare earths from an aqueous system, 3.0 molar or greater in nitric acid, increases with atomic number. At lower nitric acid concentrations deviations from this trend were observed. The mass transfer values showed a minimum at a nitric acid concentration of about 6.0 molar. Yttrium extracts in the holmium region from a highly concentrated nitric acid system, in the dysprosium region from a 6 to 12 molar nitric acid system, in the gadolinium region from a 3.0 to 4.5 molar nitric acid system and with the lighter rare earths from very low nitric acid systems. A number of 20-stage countercurrent extractions were carried out employing nitric acid solutions of yttrium and rare earths as the aqueous feed phase and tributyl phosphate as the organic phase. When extracting their concentrated nitric acid solutions, the organic product generally contained yttrium and heavy rare earths while the

aqueous product contained the light rare earth fraction plus a small amount of yttrium and dysprosium. In one multistage extraction the organic product phase delivered 90 per cent of the total yttrium which gave an oxide that was 91 per cent pure. Extraction of a light rare earth fraction resulted in an enriched concentrate of praseodymium and samarium. Gadolinium and dysprosium were separated from yttrium to a considerable extent by extracting from a very low nitric acid solution. The extractions of these yttrium-rare earth concentrates showed the possibility of separating yttrium from any particular rare earth and of some individual rare earths. The liquid-liquid system presented indicated further the applicability of solvent extraction for separating inorganic compounds. Much of the information from this work is directly applicable to practical separation problems and therefore should be readily adaptable to specific laboratory and industrial scale operations. (auth)

8365 ORNL-2279(Del.)
Oak Ridge National Lab., Tenn.
THE EFFECT OF THE RADIOCHEMICAL REPROCESSING INDUSTRY'S GROWTH ON SPENT REPROCESSING COSTS. C. E. Guthrie. June 19, 1957. Decl. with deletions Apr. 1, 1958. 23p. Contract W-7405-eng-26. $4.80(ph OTS); $2.70(mf OTS).

An economic study of radiochemical reprocessing has been made to determine the means by which reasonable reprocessing costs (less than 0.75 mill/kwh) can be attained at the earliest possible date. It is assumed that the fuel is 2% enriched uranium irradiated to 4000 Mwd/ton. In a free economy, in which plants must be built to reprocess the fuel with minimum delay, reasonable reprocessing costs will not be attained until the nuclear power capacity reaches 80,000 Mw (heat), which is expected in about 1971. Reasonable reprocessing costs can be attained in a single plant from a nuclear capacity of 28,000 Mw (heat), which may be available around 1967, if the reactor operator does not have to pay use charges on the spent fuel. Several support programs by which the government could maintain reasonable radiochemical reprocessing costs in the projected economy prior to 1971 have been investigated. The government could support fuel recovery costs with the least expense by supplying the process development, and repurchasing and stockpiling spent reactor fuels until a single economical reprocessing plant can be built by private industry. (auth)

8366 ORNL-2498
Oak Ridge National Lab., Tenn.
THE USE OF TRI-n-OCTYLPHOSPHINE OXIDE IN THE SOLVENT EXTRACTION OF ZIRCONIUM. J. C. White and W. J. Ross. Apr. 24, 1958. 38p. Contract W-7405-eng-26. $1.25(OTS).

Zirconium is extracted readily by tri-n-octylphosphine oxide (TOPO) from acidic chloride and nitrate solutions, to a lesser extent from perchlorate, but only slightly from sulfate or fluoride media. Complete extraction of zirconium from sulfate, fluoride, and tartrate solutions can be achieved with multiple equilibrations when chloride or nitrate ions, especially as $AlCl_3$ or $Al(NO_3)_3$, are added to the aqueous solutions. In chloride and nitrate systems, the extraction coefficient increases from < 10 in 1 M acids to > 1000 in 7 M HCl or HNO_3. Similar enhancement is obtained by the addition of chloride or nitrate as the salts of mono-, di-, or trivalent metals. Extraction coefficients, > 100, are achieved in 1 M acid systems that also are > 3 M with respect to chloride or nitrate. The amount of zirconium that can be extracted to > 99% in a single, 10-min. equilibration period is 40 mg from chloride and 80 mg from nitrate solution per millimole of TOPO. The efficiency of the extraction is not impaired when the aqueous to organic phase ratio is varied between 1 and 20. The extracted species are $ZrCl_4 \cdot 2[n\text{-}(C_8H_{17})_3PO]$ and $Zr(NO_3)_4 \cdot 2[n\text{-}(C_8H_{17})_3PO]$, respectively. (auth)

8367 WAPD-P-699
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
A METHOD FOR DETERMINATION OF PLUTONIUM PRODUCTION IN REACTORS. W. Baer, D. Klein, and N. Carbone. May 1956. 12p. $3.30(ph OTS); $2.40 (mf OTS).

A radiochemical separation technique for neptunium was developed to assist in the measurement of plutonium production in reactors. The method is useful in rapid determination of such quantities as the resonance escape probability and the conversion ratio with simplified experimental techniques. (auth)

8368 WIN-87
National Lead Co., Inc. Raw Materials Development Lab., Winchester, Mass.
LABORATORY INVESTIGATION OF MOONLIGHT CLAIM ORE. E. S. Porter, H. I. Viklund, and E. J. Hammond. Mar. 3, 1958. 19p. Contract AT(49-6)-924. $3.30(ph OTS); $2.40(mf OTS).

The results of laboratory metallurgical investigations of a sample of ore from the Moonlight Claim of the Industrial Minerals Corporation are reported. The amenability of the sample to acid and carbonate leaching techniques and methods of recovery of uranium from acid solution were studied. (auth)

8369
RADIOASSAY BY GAS CHROMATOGRAPHY OF TRITIUM- AND CARBON-14-LABELED COMPOUNDS. Richard Wolfgang (Yale Univ., New Haven, Conn.) and F. S. Rowland (Univ. of Kansas, Lawrence). Anal. Chem. 30, 903-6(1958) May.

A technique for the simultaneous separation by gas chromatography, mass assay, and radioactivity assay of tritium- and carbon-14-labeled organic compounds is described. Helium, which carries the material to be analyzed through the chromatography column and thermal conductivity cell, is converted into a counting gas by the continuous injection of methane. The mixed stream of helium and methane then passes through an internal proportional counter of special design, which detects the radioactivity of the material carried. The scope of this combined technique approaches that of gas chromatography itself. Because the apparatus is simple to build and operate and in view of the increasing availability of labeled compounds, the method should find a wide field of application. (auth)

8370
SEPARATIONS OF THE PLATINUM METALS BY ION EXCHANGE. S. S. Berman and W. A. E. McBryde (Univ. of Toronto, Ont., Can.). Can. J. Chem. 36, 835-44(1958) May.

Distribution coefficients for the chlorides of ruthenium, rhodium, palladium, iridium(III and IV), and platinum have been determined between the anion exchanger Amberlite IRA-400 and hydrochloric acid solutions of various molarities. Separations of various combinations of rhodium, iridium, palladium, and platinum in amounts of 0.5 mg or less are described. When, in the course of these separations, the four metals are present together, special procedures are required to ensure complete recovery of platinum. (auth)

8371
THE SEPARATION OF RHODIUM AND IRIDIUM BY ION EXCHANGE. S. S. Berman and W. A. E. McBryde (Univ.,

of Toronto, Ont., Can.). Can. J. Chem. 36, 845-52(1958) May.

Separations of rhodium and iridium as chlorides by means of columns of the anion exchanger Amberlite IRA-400 are described. Iridium is maintained in the quadripositive state by the addition of cerium(IV), the presence of which is necessary to counteract the reducing action of the resin. The marked difference in affinity toward the resin of Ir(IV) and Rh(III) makes the separation possible. Rhodium can easily be eluted from the resin by 2M hydrochloric acid. Removal of all the iridium from the resin is accomplished in a Soxhlet extractor with 6M hydrochloric acid. A number of less successful procedures for this separation are discussed. (auth)

Spectroscopy

8372 AEC-tr-3174

ULTRAVIOLET ABSORPTION OF NITRATES AND CHROMATES AT 20°K. (Ultraviolettabsorption von Nitraten und Chromaten bei 20°K.) Hildegard Schaumann. Translated from Z. Physik 76, 106-32(1932). 33p.

The absorption spectra of Na, K, and Ba nitrates as well as of potassium chromate and potassium dichromate in the dissolved as well as in the crystalline states are photographed at room temperature and at 20°K in the spectral range between 4,200 and 2,400 λ. The nitrates are investigated in the form of crystals of 0.1 to 1.7 mm thickness, and the chromates are investigated in layers of a few tenths μ which have been vaporized on quartz plates. It could be shown that the spectra of crystals at room temperature in contrast to solution spectra have been shifted generally in the direction of shorter and partly also in the direction of longer wavelengths. At low temperatures, the investigated bands are divided on the whole into a greater number of individual bands which in all cases have a distance of 800 cm^{-1} ± 100 from each other. An additional division which has been observed in the case of potassium nitrate is brought into relation with the pleochroism of the crystal and proved qualitatively under polarized light. A considerable decrease of the total absorption apparently takes place in the corresponding bands in all cases simultaneously with the division. (auth)

Syntheses

8373 ORNL-1962

Oak Ridge National Lab., Tenn.

THE PRODUCTION OF C^{14} BY THE Be_3N_2 PROCESS. R. P. Shields. Feb. 1, 1956. 14p. Contract W-7405-eng-26. $0.20(OTS).

The first C^{14} produced under the Radioisotope Program of the Atomic Energy Commission was made by the ORNL Physics Division with equipment that circulated a saturated solution of ammonium nitrate through the graphite reactor. The process was discontinued when a program for irradiating calcium nitrate was started in 1946. The calcium nitrate program was terminated by December 1950, at which time the beryllium nitride process was under way. In the beryllium nitride process, sulfuric acid is used to dissolve the beryllium nitride, thereby releasing the organic compounds and carbon dioxide which contain the C^{14}. These gases are carried by a stream of nitrogen through a gas train, which includes a CuO furnace to oxidize the organic compounds, and through sodium hydroxide scrubbers to absorb the carbon dioxide. The product is obtained by precipitating the carbonate from the scrubber solution with barium hydroxide. (auth)

8374 WADC-TR-57-764

Wright Air Development Center. Materials Lab., Wright-Patterson AFB, Ohio.

FLUORINE CONTAINING CHELATE COMPOUNDS. Glenn R. Buell. Nov. 1957. 15p. Project title: RUBBER, PLASTIC AND COMPOSITE MATERIALS. Task title: SYNTHESIS AND EVALUATION OF NEW POLYMERS. (AD-150984).

A study was made of the feasibility of preparing liquid chelate compounds. The thermal stability of certain chelate compounds led to their study as possible liquid base stock materials. Several fluorinated diketones were chelated with metal ions and their melting points studied to determine the effect of the fluorine on the physical properties of the molecule. Only one liquid was obtained and all compounds exhibited high vapor pressures. (auth)

Transuranic Elements and Compounds

Refer also to abstracts 8323 and 8367.

8375 KAPL-1007

Knolls Atomic Power Lab., Schenectady, N. Y.

INFRARED SPECTRUM AND THERMODYNAMIC PROPERTIES OF PuF_6. N. J. Hawkins, H. C. Mattraw, and W. W. Sabol. May 24, 1954. Decl. Oct. 13, 1955. 21p. Contract W-31-109-Eng-52. $0.15(OTS).

The infrared spectrum of PuF_6 was observed from 2 to 23 μ. The spectrum exhibited a very intense band centered at 617 cm^{-1} which was assigned as the fundamental ν_3. A number of combination bands was observed which indicated that the molecule had the symmetry of the O_h point group and from which values of the other five fundamental vibration frequencies could be calculated. Upon comparison of the vibration spectrum of PuF_6 with UF_6, it was noted that the Pu–F bond distance is shorter than the U–F bond distance in UF_6. The heat capacity at constant pressure, the entropy, and the free energy function $-(F^0-E_0^0)/T$ were calculated for various temperatures between 100 and 500°K for one mol of the perfect gas at atmospheric pressure using the harmonic oscillator–rigid rotor approximation. The results at 25°C are: C_p^0 is 30.901, S^0 is 88.03, and $-(F^0-E_0^0)/T$ is 67.24, all in cal/°K/mol. (auth)

8376

DETERMINATION OF THE COMPOSITION AND DISSOCIATION CONSTANT FOR OXALATE COMPLEXES OF Pu^{+3} COMPOUNDS BY ION EXCHANGE. A. D. Gelman, N. N. Matorina, and A. I. Moskvin. Atomnaya Energiya 4, 52-6(1958) Jan. (In Russian)

The method of ionic exchange was used in the investigation of the Pu^{3+} complex formation in oxalate solutions in the interval pH 1.4 to 3.0. It has been shown that the complex ions $Pu(C_2O_4)_2^-$ and $Pu(HC_2O_4)_2^-$ with the instability constants $K_1 = 7.1 \times 10^{-10}$ and $K_2 = 1.1 \times 10^{-11}$ are formed in the given pH range. The magnitudes of $Pu(C_2O_4)_2^-$ instability constants coincide satisfactorily with the instability constants of the corresponding ionic complex obtained by the solubility method. (tr-auth)

8377

POLAROGRAPHIC METHOD OF STUDIES OF COMPLEX PLUTONIUM OXALATES. V. V. Fomin, S. P. Vorol'ev, and M. A. Andreeva. Atomnaya Energiya 4, 57-62(1958) Jan. (In Russian)

Polarographic studies were made of the composition and stability of tri- and tetra-valent Pu in oxalate solutions. Complexes of $Pu(C_2O_4)_4^{4-}$ and $Pu(C_2O_4)_4^{5-}$ were formed in potassium oxalate solutions with pH 3.5 to 6. In the above conditions the Pu^{4+} produced a well expressed wave reac-

tion suitable for quantitative polarographic determination. The oxidation-reduction potential of the reaction in 1M potassium oxalate equaled 0.205 v. Two simultaneous complexes of Pu^{4+} were observed in the solution with pH 6 to 8. The instability constants for the complex oxalate ions $Pu(C_2O_4)_3^{2-}$ and $Pu(C_2O_4)^{5-}$ were determined on the basis of the solubility of $Pu(C_2O_4)_3^{2-}$ and on the basis of the polarographic data for $Pu(C_2O_4)_4^{4-}$. (tr-auth)

8378

INVESTIGATION OF THE OXALATE AND CARBONATE COMPLEXES OF PLUTONIUM(IV) IN AQUEOUS SOLUTIONS BY THE SOLUBILITY METHOD. A. D. Gel'man and A. I. Moskvin. Doklady Akad. Nauk S.S.S.R. 118, 493-6 (1958). (In Russian)

The content and instability constants of oxalate and carbonate complexes of Pu^{4+} were analyzed. The solubility of $Pu(C_2O_4)_2 \cdot 6H_2O$ in various solutions and the solubility of $Pu(OH)_4$ in aqueous solutions of K_2CO_3 are tabulated. A qualitative comparison of the relative tendencies of Pu^{3+}, Pu^{4+}, and Pu^{6+} to complex formation was made, based on data on the stability of Pu oxalate complex ions in various valence states. Tables of ionic potentials of Pu in various valence states and instability constants of complex Pu^{4+} ions are included. (R.V.J.)

8379

PROBLEMS AT THE MARCOULE PLUTONIUM PLANT AND THEIR SOLUTIONS. R. Galley. Energie nucléaire 2, 2-20(1958) Jan.-Mar. (In French)

The industrial problems of plutonium extraction are connected with the low plutonium content of the uranium bars and with the high activity of the bars which necessitates stringent protective measures. The general production scheme used at Marcoule is indicated. The concentration of the separated fission products is made in two evaporation stages. Plutonium, concentrated by precipitation and selective fixation of resins, is precipitated as the oxalate and then reduced to the metal. (tr-auth)

8380

THE CHEMICAL PROPERTIES OF PLUTONIUM IN WATER SOLUTION. A. Pasternak (Inst. of Nuclear Research, Warsaw). Nukleonika 3, 53-68(1958). (In Polish)

The position of Pu in the periodic table is analyzed. The oxidation states and various forms of Pu in aqueous solutions are discussed, as well as the hydrolysis, polymerization, formation of colloids, and polyanions. The dismutation power of Pu ions and the formation of complexes of Pu ions in all their oxidation states with simple inorganic anions and with hydrogen peroxides are discussed. (tr-auth)

8381

HYPERFINE STRUCTURE MEASUREMENTS ON NEPTUNIUM-239. J. C. Hubbs and R. Marrus (Univ. of California, Berkeley). Phys. Rev. 110, 287-9(1958) Apr. 1.

The atomic-beam magnetic-resonance method has been used to investigate the 2.36 day Np^{239} in the low-field or Zeeman region of hyperfine structure. The spin of this nuclide is found to be $^5/_2$, in agreement with the conclusions of Hollander, Smith, and Mihelich from beta and gamma spectroscopy and with the predictions of the Bohr-Mottelson model, but apparently in conflict with measurements by the methods of optical and paramagnetic spectroscopy. (A.C.)

Tritium and Tritium Compounds

Refer to abstract 8329.

Uranium and Uranium Compounds

Refer also to abstracts 8314, 8322, 8353, 8354, 8355, 8356, 8357, 8358, 8359, 8361, and 8368.

8382 AECU-3674

Westinghouse Electric Corp. Research Labs., [East] Pittsburgh, Penna.

OXIDATION OF URANIUM DIOXIDE. Research Report No. 100FF942-R2(Revised). Paul E. Blackburn, Joseph Weissbart, and Earl A. Gulbransen. Aug. 2, 1957. 22p. For [Westinghouse Electric Corp.] Bettis Plant. $4.80 (ph OTS); $1.70(mf OTS).

The results of kinetic, x-ray, and density studies of the UO_2 oxidation products indicate that UO_2 oxidizes by the immediate formation of a surface γ-tetragonal U_3O_7 phase. This process is controlled by the diffusion of oxygen through the second phase. Analysis of the $\alpha-UO_2$ lattice parameters demonstrates that the solubility of oxygen in UO_2 below 300°C is less than one atom percent per mole of UO_2. The stability of U_3O_7 and the interpretation of other authors' results are discussed. (auth)

8383 CRL-51

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

URANIUM DIOXIDE—A PROMISING NUCLEAR FUEL. O. J. C. Runnalls. Jan. 1958. 35p. (AECL-553). $1.00 (AECL).

A Metallurgy Seminar to be presented at the Univ. of Toronto, Jan. 24, 1958 and at McMaster Univ., Feb. 20, 1958.

It is probable that several large natural uranium power reactors, moderated and cooled with heavy water, will be built in Ontario by 1980. The problem of selecting a fuel for such reactors has been intensively studied during the past two years. As a result, it is suggested that uranium dioxide clad in a zirconium alloy will meet the required specifications of corrosion resistance, irradiation stability and economic fabrication costs. A diversified experimental program has been established to develop cheap fabrication techniques and to determine the operating limits of uranium dioxide when irradiated in water at temperatures up to 300°C. (auth)

8384 KAPL-1702

Knolls Atomic Power Lab., Schenectady, N. Y.

THE THERMAL STABILITY OF URANIUM DIOXIDE. L. G. Wisnyi and S. W. Pijanowski. Nov. 1, 1957. 20p. Contract W-31-109-Eng-52. $0.75(OTS).

The melting point of uranium dioxide was determined in hydrogen, helium, and argon to be 2760 ± 30°C. From lattice constant measurements, it was concluded that in all cases the melted material was uranium dioxide, and not a lower oxide. From the results obtained during thermal analysis experiments in a vacuum, the accepted cubic form was established as the only stable phase of uranium dioxide up to 2500°C. (auth)

8385 KAPL-M-LJK-1

Knolls Atomic Power Lab., Schenectady, N. Y.

INVESTIGATION OF THE STRUCTURE OF AMMONIUM URANYL CUPFERRATE $NH_4[UO_2(C_6H_5N_2O_2)_3]$. L. J. Katz. Sept. 1957. 6p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

The ammonium uranyl cupferrate group has been shown to be primitive cubic with four molecules per unit cell, the locations of the carbon, nitrogen, and oxygen atoms in this structure were investigated. (J.R.D.)

8386
THE PLANT AT BOUCHET. Denise Gallon. Energie nucléaire 2, 35-7(1958) Jan.-Mar. (In French)

A description is given of the procedures followed at Bouchet for the production of nuclear purity uranium metal. The starting material is sodium uranate obtained from the mineral processing plants. (tr-auth)

Waste Disposal

8387 HW-54509
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
CHEMICAL DECONTAMINATION OF THE INTERNAL SURFACES OF REACTOR COOLANT SYSTEMS. Carl M. Unruh. Mar. 31, 1958. 10p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

A number of chemical reagents prepared especially for decontamination of reactor plumbing were evaluated as to corrosiveness, cost, effectiveness, and safe disposal. Turco 4306-B (a patented reagent composed of sulfamic acid, fluorides, chlorides, a sulfonic base soap and wetting agent) was recommended for decontamination of aluminum and stainless steel surfaces, hand tools, and small parts. (J.R.D.)

8388 KAPL-569
Knolls Atomic Power Lab., Schenectady, N. Y.
DISPOSAL OF LIQUID WASTES AT THE KNOLLS ATOMIC POWER LABORATORY. M. M. Cohn, L. L. German, and C. N. Perleberg. June 8, 1951. Changed from OFFICIAL USE ONLY June 3, 1957. 33p. Contract W-31-109-Eng-52. $6.30(ph OTS); $3.00(mf OTS).

The liquid wastes at KAPL are separated into two categories, regulated and unregulated effluent. Section I is devoted to the source, treatment, and subsequent discharge of the unregulated or nonradioactive effluent. Section II presents the source, processing, and ultimate disposal of radioactive wastes together with a summary of the radioactivity content of all liquid wastes discharged into the Mohawk River. (W.L.H.)

8389
AEROSOL PENETRATION THROUGH SAND. R. E. Yoder (Oak Ridge National Lab., Tenn.). Proc. Health Phys. Soc. 165-76(1957).

The use of sand to filter radioactive aerosols from the boiling of high level power reactor wastes was investigated. As the penetration of the aerosol depends on the particle size, a rapid method of particle size determination for homogeneous aerosols in the 0.1 μ to 1.0 μ radius range was developed. Three sands have been used in the aerosol filtration experiments. The aerosol size for maximum penetration was determined. The results show that a decontamination factor of 10^{12} is possible with dry sand. (J.S.R.)

ENGINEERING

8390 CF-57-12-24
Oak Ridge National Lab., Tenn.
NOTES ON USE OF TURBO BLOWERS. W. T. Furgerson. Dec. 4, 1957. 9p. Contract [W-7405-eng-26]. $1.80 (ph OTS); $1.80(mf OTS).

The Gas Cooled Reactor Project calls for the use of a number of turboblowers operating in parallel circuits. Certain characteristics of these machines which must be taken into account when designing the system in which they are to be used, when writing specifications for the blower, and when determining plant operational procedures are pointed out. (W.L.H.)

8391 CF-58-4-80
Oak Ridge National Lab., Tenn.
BLOWER SYSTEM DYNAMICS. W. T. Furgerson. Apr. 16, 1958. 15p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

An analysis is presented of the dynamics of a turboblower acting together with its connecting circuit. This is to be distinguished from the aero-thermodynamics involved in the design of the blower itself. The effect on system stability of blower and circuit characteristics is discussed. (auth)

8392 NACA-RM-E54D27
Lewis Flight Propulsion Lab., Cleveland.
HIGH-TEMPERATURE LUBRICANTS AND BEARINGS FOR AIRCRAFT TURBINE ENGINES. July 19, 1954. Decl. June 20, 1957. 103p.

The problems, research status, and future possibilities for high-temperature lubricants and bearings for aircraft turbine engines are discussed. Higher operating temperatures are inevitable for bearings and lubricants. Liquid lubricants may be usable at high temperatures in closed lubrication systems. At 1000°F, where liquid lubricants may not be useful, solids and gases show promise. Tool steels show promise for high-temperature bearings. (auth)

8393 NP-6662
Stanford Research Inst., Menlo Park, Calif.
SYNTHESIS AND EVALUATION OF HIGH TEMPERATURE ANTIOXIDANTS FOR SYNTHETIC HYDRAULIC FLUIDS AND LUBRICANTS. Quarterly Progress Report No. II [for] August-October 1957. (Report No. 6). R. M. Silverstein. Nov. 15, 1957. 21p. Contract AF33(616)-5276.

Additives in a concentration of 0.2% from each of the three classes listed in SRI Report No. 3 (i.e., aromatic and heterocyclic compounds, metal chelates, and meta-carbon compounds) were tested in F-50 silicone fluid at 500°F for 48 hr at a flow rate of 1 L of dry air per hour. All of the effective additives fall into the class of aromatic and heterocyclic compounds, and the most effective of these materials can be classified as condensed aromatic ring compounds. Both fluoranthene and 1,2-benzanthracene were almost as effective in reducing viscosity increase as N,N'-di-2-naphthyl-p-phenylenediamine (the standard for comparison) and were considerably more soluble in the silicone fluid. At the end of the 48-hr runs, the silicone fluid containing N,N'-di-2-naphthyl-p-phenylenediamine was brown and opaque although no precipitate settled out on centrifugation. Fluoranthene and 1,2-benzanthracene yielded clear yellow fluids under the same conditions. Other effective, though less soluble, condensed aromatic ring compounds were dinaphthylene-thiophene (which contains a hetero S-atom), chrysene, and decacyclene. The compounds 1,1'-binaphthyl and 2,5-diphenyloxazole were soluble and at least moderately effective. Indanthrene Navy Blue BRA Powder and 4,4'-bis-(dimethylamino)benzophenone were moderately effective but only slightly soluble. (auth)

8394 NP-6663
Stanford Research Inst., Menlo Park, Calif.
SYNTHESIS AND EVALUATION OF HIGH TEMPERATURE ANTIOXIDANTS FOR SYNTHETIC HYDRAULIC FLUIDS AND LUBRICANTS. Quarterly Progress Report No. III for November 1957-January 1958. (Report No. 9). R. M. Silverstein. Feb. 15, 1958. 28p. Contract AF33(616)-5276.

A number of additives were found to be effective in preventing oxidative degradation of F-50 silicone oil at 500°F with dry air for 48 hr. With a single exception, all of the effective additives fall into the class of aromatic and heterocyclic compounds, and the most effective of these compounds, except for one, can be classified as condensed aromatic ring compounds. Several of the effective additives are also soluble in the silicone oil. Apparently, condensed aromatic ring compounds containing three or more rings are effective as a class in F-50 silicone oil. Paraffinic mineral oil MLO 57-574 and silane fluid MLO 57-461 were degraded to black tars at 500°F with dry air; none of the additives tested was effective in preventing this degradation. Silane fluid MLO 57-628 was much more stable than silane fluid MLO 57-461. However, even the more stable fluid was degraded to a considerable extent after 48 hr at 500°F with dry air. Several of the additives screened seemed to show some activity, but more runs are needed to verify this tentative observation. Several ferrocene derivatives were prepared in the synthesis phase of the program. (auth)

8395 P-498(RAND)
RAND Corp., Santa Monica, Calif.
A METHOD FOR DETERMINING THE EFFECTS OF ELEVATED TEMPERATURE ON STRUCTURAL DESIGN AND WEIGHT. W. R. Micks. Mar. 1954. 65p.

A method is presented for including temperature and time effects in the determination of allowable stresses for structures that operate at elevated temperatures. Creep-buckling and permanent structural deformation are considered, as well as the static, or short-time properties of the material at elevated temperature. Results are obtained in a form that can be used for preliminary-design weight estimation. Recommendations are made regarding research needed to form a basis for structural design at elevated temperatures. (auth)

8396 UCRL-5083
California. Univ., Livermore. Radiation Lab.
BIBLIOGRAPHY ON HIGH PRESSURE SYSTEMS AND HIGH PRESSURE–HIGH TEMPERATURE SYSTEMS; TECHNIQUES, APPARATUS AND EXPERIMENTAL DATA. John F. Lakner, comp. Jan. 10, 1958. 40p. Contract W-7405-eng-48. $6.30(ph OTS); $3.00(mf OTS).

The bibliography on high pressure-high temperature and high pressure systems is the result of an investigation into the equipment and experimental technique needed to increase the density of powdered compounds, especially those compounds which possess a high vapor pressure of hydrogen at moderate temperatures and pressures. Particular emphasis was given to those articles which discussed the pressure vessel construction in detail, method of internal heating, materials of construction for use under hydrogen atmosphere, and articles which gave experimental data on compounds other than the ones worked with at UCRL. (J.E.D.)

Heat Transfer and Fluid Flow

8397 AECU-3631
California. Univ., Los Angeles. Dept. of Engineering.
FURTHER REMARKS ON THE STABILITY OF BOILING HEAT TRANSFER. Report 58-5. Novak Zuber and Myron Tribus. Jan. 1958. 71p. Project 34. Contract AT(11-1)-34. $2.00(OTS).

An analytical expression is presented which permits the prediction of the maximum nucleate heat flux in pool boiling of saturated or subcooled liquids. The numerical values of the empirical constants which appear in the Kutateladze and Borishanskii criteria for the "burnout" heat flux are derived from the theory. An analytical expression for the empirical function which appears in the correlation of Griffith is also derived. The hitherto unexplored features of transition boiling, i.e., the hydrodynamic instability, the well defined geometrical configuration and the frequency dependence are described, supported by experimental evidence, and used as the basis for the analytical work. The peak heat flux in transition boiling is shown to be limited by the combined effects of Taylor and Helmholtz instabilities; whereas the minimum transitional heat flux is limited by the effect of Taylor instability only. The analysis leads to the conclusion that because of the statistical nature of the disturbances and the "bandwidth" of the unstable wavelengths which govern the process, an inherent uncertainty exists in determining the exact value of the heat flux at "burnout." The width of this uncertainty range is ±14%. The often noted poor reproducibility of experimental data on "burnout" can be inferred, therefore, from the analysis. The reason analytical attacks upon the "burnout" problem, based upon considerations of bubble agitation and other nucleate boiling characteristics, have not been successful is discussed. The literature has shown conclusively that the surface conditions play the dominant role in determining the superheat accompanying a given heat flux. The analysis reveals, in addition, that even if the nucleating characteristics of the surface were known the problem could still not be solved from these considerations because the mechanism of the instability occurs in the fluid away from the surface. The extension of the analysis to flow systems is briefly discussed. (auth)

8398 AECU-3673
Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.
SATURATED WATER ORIFICE TESTS. Test Specification 612150. Jan. 22, 1957. 5p. $1.80(ph OTS); $1.80(mf OTS).

The object of this test was to determine the relationship which governs the flow of saturated water through sharp-edge orifices and orifices of finite length. (auth)

8399 ANL-5787
Argonne National Lab., Lemont, Ill.
TWO-PHASE AIR-WATER FLOW PHENOMENA. Michael Petrick. Mar. 1958. 88p. Contract W-109-eng-38. $2.25(OTS).

An experimental two-phase flow study was conducted on a series of Lucite rectangular channels with aspect ratios of 2 to 16 using an air-water system at atmospheric pressure. The objectives of the study were: (1) to determine the effect of sudden changes of flow area on the density of two-phase fluids; (2) to investigate the effect of mass flow rate on the two-phase friction factor multiplier; and (3) to develop a sound method of measuring the density of a two-phase fluid in large conduits. The density of the air-water mixture changed during either an expansion or contraction of flow area; however, the magnitude of the change was not great and was readily predicted by a semi-theoretical equation. A sizeable effect of mass flow rate on the two-phase friction factor multiplier was found which was not accounted for in the widely used Martinelli correlation. A traversing technique was developed for measuring the density of a two-phase fluid which also gave a continuous trace of the phase distribution. The method was tried on Lucite mockups of simulated two-phase flow patterns, and excellent agreement was obtained between the measured and calculated voids. (auth)

8400 CF-58-2-49
Oak Ridge National Lab., Tenn.
REED BESLER BOILER HIGH PRESSURE STEAM SYS-

TEM AND THERMAL CYCLING FACILITY. Summary Report. P. P. Holz. Feb. 12, 1958. 12p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

A high pressure boiler has been installed at ORNL. This Besler boiler is capable of producing from 150 to 2000 psi saturated steam at steaming rates up to 5000 lbs/hr. The boiler is part of a water-steam circuit which also includes two spray water pumps, a steam pressure control valve, a high pressure trapping station, and a low pressure deaerated feedwater system. The new boiler system is piped and instrumented to serve as a thermal cycling facility. Shakedown test thermal cycles to requirements set forth in HRT Specification 1113a have been conducted using the existing Dump Test Autoclave as a test piece. Fourty-four cycles have been run through mid February, 1958. The boiler has been operated a total of 142 hours. Cycles are run completely automatically. Better than three-fourths of the cycles as run fall within the specification prescribed limits. (auth)

8401 IGR-TN/W-832

United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England.
HEAT TRANSFER IN CHANNELS COMPOSED OF ROUGH AND SMOOTH SURFACES. W. B. Hall. Feb. 1958. 13p.

Measurements of the heat transfer and fluid flow properties of a rough surface are conveniently made on a roughened rod placed centrally in a smooth channel. Such experimental data cannot be applied directly to most fuel element assemblies, since the shape of the passages and the proportion of rough to smooth surfaces will be different. A method of transforming the experimental results so that they may be applied to certain types of fuel element assembly is proposed. (auth)

8402 M-1183

Columbia Univ., New York. Div. of War Research.
LIQUID DISTRIBUTION THROUGH STEDMAN PACKING. W. C. Zmachinsky. Oct. 23, 1944. Decl. Mar. 20, 1957. 13p. Project SAM. Contract W-7405-eng-50. (100-B-R-233). $3.30(ph OTS); $2.40(mf OTS).

A five foot section of Stedman packing was suspended vertically, and trichloroethylene was introduced into the packing in four different ways by means of a continuous stream from an overhead tank. The four methods of introducing feed were: through a distributor plate, at a single central point, a single point on wall, and circumferentially on wall. The fluid was collected in four equal quadrants or annuli. Tests were made for flow distribution both before and after flooding the section. Tables are given for variable flow rates and percent liquid collected in the four equal areas. (W.D.M.)

8403 NP-6637

Massachusetts Inst. of Tech., Cambridge. Div. of Industrial Cooperation.
VOID VOLUMES IN SUBCOOLED BOILING SYSTEMS. Technical Report No. 12. Peter Griffith, John A. Clark, and Warren M. Rohsenow. Mar. 1, 1958. 40p. DSR Project No. 7-7673. Contract N5ori-07894.

The void volumes in systems at 500, 1000, and 1500 psia were investigated, and a method of predicting these volumes is presented. A comparison was made of measured and predicted volumes using data collected at 2000 psia. (J.R.D.)

8404 NP-6661

MSA Research Corp., Callery, Penna.
PROGRESS REPORT NO. 45 FOR FEBRUARY AND MARCH 1958. W. J. Posey, ed. Apr. 15, 1958. 42p. Contract NObs-65426.

Tests were conducted with 175°F circulating water at a flow rate of 1800 gpm in a 6-in. loop to confirm the hydrodynamic design of the A1W core. A set of curves were plotted showing the evaluated data obtained in the nucleate and film boiling regions for water at a flow rate of 4.33×10^5 lb/hr-ft^2 with an inlet enthalpy of 415.6 Btu/lb. Meltdown and fission product release studies were continued. Five modes of meltdown and one fission product release run are reported. (For preceding period see NP-6588.) (D.E.B.)

8405 WAPD-CTA-EL-3581

[Westinghouse Electric Corp. Bettis Plant, Pittsburgh.]
SATURATED WATER ORIFICE TESTS. Preliminary Test Report T-612150. R. T. Graulty. Feb. 28, 1957. 62p. $10.80(ph OTS); $3.90(mf OTS).

It was proposed to determine the relationship which governs the flow of saturated water through sharp-edge orifices and orifices of finite length. The data obtained on $\frac{1}{4}$ in. diameter test orifices are included. (M.H.R.)

8406 WAPD-TH-338

[Westinghouse Electric Corp. Bettis Plant, Pittsburgh.]
HOT PATCH BURNOUT TESTS IN 0.097 in. × 1 in. × 27 in. LONG RECTANGULAR CHANNELS AT 2000 PSIA. A. Weiss. July 8, 1957. 12p. $3.30(ph OTS); $2.40 (mf OTS).

A series of upflow burnout tests were conducted in the Bettis Burnout Loop No. 23 on a 0.097 in. × 1 in. × $27\frac{1}{16}$ in. long ($L/D_e = 140$) test specimen that contained a local "hot patch" which had a flux peak 1.98 times that existing in the remainder of the test specimen. The "hot patch" was $1\frac{3}{8}$ in. long ($L_{patch}/D_e \approx 7$) located $\frac{3}{8}$ in. from the exit of the channel. The range of variables investigated were mass velocities of 0.35×10^6 to 2.0×10^6 lb/hr-ft^2 at inlet temperatures of 100, 300, and 500°F. The results of these tests indicate a peak effectiveness varying from 100 to 4% as the enthalpy at burnout varies from 550 Btu/lb to 918 Btu/lb. (auth)

8407

HYDRODYNAMICS OF A REACTING AND RELAXING FLUID. R. M. Mazo and J. E. Mayer (Univ. of Chicago). J. Appl. Phys. 29, 735-6(1958) Apr.

In a paper with the same title as this one, Kirkwood and Wood (J. Appl. Phys. 28, 395(1957)) presented a phenomenological theory of flow in a fluid capable of chemical reactions and internal relaxations. The basic assumption is that there exist degrees of freedom, each of which may be regarded as a thermodynamic system in local equilibrium, but that equilibrium is not necessarily obtained between classes. Each class i has associated an energy E_i and a temperature T_i. For a process at constant composition, T_i is to obey the equation $dT_i/dt = Q_i$, where Q_i is a function of local state. Q_i is generally unknown, and is usually approximated by $Q_i = (T_i - T_i)/\tau$, where T_i is the translational temperature. The present note discusses the validity of the equation $dT_i/dT = Q_i$ in a reacting system, assuming it is valid at fixed composition, by means of a simple example. (A.C.)

8408

TEST LOOP FOR DETERMINING BURNOUT HEAT FLUX. W. Milich and E. C. King (MSA Research Corp., Callery, Penna.). Nucleonics 16, No. 4, 108-9(1958) Apr.

A description is given of an experimental two-fluid loop in which NaK is the heating medium and which is used to study the maximum nucleate boiling point, or burnout heat flux, of any fluid as a function of pressure, temperature, and velocity and to study film boiling beyond the burnout point. Results of tests made with isopropyl biphenyl are shown. (J.S.R.)

Materials Testing

8409 GAT-L-305
Goodyear Atomic Corp., Portsmouth, Ohio.
TESTING OF M-11 GAS MASK CANISTERS IN WET AIR CONTAINING URANIUM HEXAFLUORIDE. F. A. Koehler and P. J. Daloisi. Feb. 1, 1957. 5p. Contract AT(33-2)-1. $1.80(ph OTS); $1.80(mf OTS).

A study was made of the change with time in the resistance of M-11 gas mask canisters to the flow of wet air containing 200 ppm by weight of UF_6 and its subsequent hydrolysis products. At a flow of 85 liters per minute of contaminated air drawn through in the usual direction, a change in pressure drop of one inch of water occurred in approximately 36 minutes. With air flowing in the reverse direction, the average time for a one-inch increase was about 11½ minutes. (auth)

8410 NYO-3577(Del.)
New York Operations Office, AEC.
NEW GERMAN INSTRUMENTS FOR NON-DESTRUCTIVE TESTING AND THEIR APPLICATIONS TO COMMISSION PROBLEMS. [A Summary of Information Gained on a Visit to the Institute Dr. Förster, Reutlingen, Germany, July 1952]. Richard Hochschild. Aug. 28, 1952. Changed from OFFICIAL USE ONLY with deletions Jan. 7, 1958. 64p. $10.80(ph OTS); $3.90(mf OTS).

An unusual group of non-destructive testing instruments was developed in Germany during the past decade. Most of the more than 50 types of instruments in this group depend on eddy current and magnetic testing techniques, and are applicable to flaw and quality tests of metal bars, tubes, and many miscellaneous parts. This report considers applications of these instruments to Commission problems. Of particular interest are methods for the non-destructive testing of bare and canned uranium slugs and flat-plate fuel elements, uranium bars, and ingots, and stainless steel tubing. Measurement principles and, when available, practical results are outlined with some emphasis on the limitations and technical difficulties of the Förster equipment. Solutions to technical problems that were discussed with Dr. Förster are summarized. Recommendations are made as to what action should be taken to utilize the methods in the Commission's non-destructive testing program. In conclusion, production facilities are considered as is the question of supply of these instruments to the United States. (auth)

8411 KAPL-M-AJP-2
Knolls Atomic Power Lab., Schenectady, N. Y.
IMMERSION ULTRASONIC TEST ON A KAPL-30 ELEMENT. A. J. Pardus and W. R. Plant. Aug. 6, 1956. 10p. $1.80(ph OTS); $1.80(mf OTS).

A brief description is given of immersion ultrasonic tests on a KAPL 30 element #K55-56, with photomacrographs of cross and longitudinal sections of the element taken at selected locations, including both "good" and "faulty" predictions. Comparison with radiographic results is made, and it is shown that radiography is not completely effective for determination of bond imperfections. (auth)

8412 AEC-tr-3190
EXPERIENCES WITH ULTRASONIC INSPECTION OF MATERIAL AND IN PARTICULAR WELD INSPECTIONS [II]. (Enige Ervaringen met Ultrasonisch Materiaalonderzoek, in het Bijzonder Betreffende het Lasonderzoek II). W. deJong and G. J. Janssen. Translated from Polytech. Tijdschr. 8, 602A-7A(1953). 15p.

A defect is detected by inspecting the weld from both sides by means of the reflection method. When inspecting welds in flat surfaces, in longitudinal seams in pipes, drums, etc., use is made of the so-called "hinged transducers." "Perspex" auxiliary parts are used to send transverse vibrations at an angle into the material. By adjusting the angle between the transducers and the corresponding distance between the transducers and the weld, the sound reverberated by a defect is registered by the receiver. The echos from various types and sizes of defects are analyzed. (W.D.M.)

Waste Disposal

8413
REMARKS ON HEAT PROBLEMS IN THE LONG TERM STORAGE OF HIGH LEVEL RADIOACTIVE LIQUID WASTES. M. Weber (Chemical Research, Prague). Jaderna Energie 4, No. 2, 39-42(1958). (In Czech.)

8414
PROBLEMS IN THE INCINERATION OF RADIOACTIVE WASTE. H. S. Jordan (Los Alamos Scientific Lab., N. Mex.). Proc. Health Phys. Soc. 152-8(1957).

An attempt is made to develop criteria for evaluating incineration as a process to assist in the disposal of contaminated waste, to indicate features that should be considered in the design of an incinerator for a large installation, and to evaluate the usefulness of the process for a small installation. (J.S.R.)

MINERALOGY, METALLURGY, AND CERAMICS

Ceramics and Refractories

8415 AFOSR-TN-58-251
Illinois. Univ., Urbana.
THE EFFECT OF SINGLE OXIDE ADDITIONS ON THE DEVITRIFICATION TENDENCIES OF A BARIUM-BORO-SILICATE CERAMIC COATING GLASS. Report No. 80. Raymond R. Reschetz, William R. Bratschun, Richard M. Spriggs, and Dwight G. Bennett. Sept. 1957. 32p. Contract AF18(603)-28. (AD-154154).

The effect of single oxide additions of calcia, titania, ceria, bismuth oxide and zinc oxide on the devitrification tendencies of a barium-boro-silicate glass was investigated. Coated specimens on type 347 stainless steel were examined by x-ray diffraction after exposures at 871°C for times up to 150 hours. All of the additions studied delayed to some extent the initial appearance of the devitrification products as compared to the base glass. All coatings of the ceria and zinc oxide series plus those compositions with smaller molar additions of TiO_2 and Bi_2O_3 appeared to retain their continuity and dimensional stability after 150 hours of heating at 871°C. Of these, the coating with 1.50 moles of ceria appeared to be the best. This coating, as well as the coating with 2.00 moles of ZnO, exhibited the least crystalline change over the 150 hours of heat treatment at 871°C. Powder patterns on selected coating samples revealed the existence of preferred orientation and selective crystallization at or near the coating surfaces. Although certain coatings exhibited considerable crystalline activity, they still retained continuity and stability characteristics. (auth)

8416 SCTM-112-58(15)
Sandia Corp., Albuquerque, N. Mex.
MEASURING REMANENT POLARIZATION OF FERROELECTRIC CERAMICS. R. W. Kulterman and A. J. Shell.

Apr. 16, 1958. 35p. Contract AT(29-1)-789. $6.30(ph OTS); $3.00(mf OTS).

Four methods for measuring the remanent polarization of a ferroelectric ceramic are discussed. The first method discussed is the pyroelectric method. This method is limited by the finite resistivity of the material and by anomalous charge flow. Two mechanisms are discussed as probable causes of this anomalous effect. The second method for measuring remanent polarization is by means of electric displacement versus electric field loops. The limitation of this method is the voltage breakdown of the ceramic. A third method is presented which makes use of a relationship existing between the electromechanical coupling coefficient and the remanent polarization. The coupling coefficient is measured by small-signal resonance and antiresonance measurements and the remanent polarization is then read from an empirically established curve. The limitation of this method is the geometry of the ceramic. The fourth method (and the one with probably the broadest application) would be to make use of a reproducible polarizing process. (auth)

8417 WADC-TR-57-535

Mallory (P. R.) and Co., Inc. Metallurgical Research Lab., Indianapolis.

A STUDY OF THE POSSIBILITY OF REINFORCING HIGH-TEMPERATURE ALLOYS BY ADDITION OF REFRACTORY POWDERS. Period covered: April 1956 to July 1957. John D. Burney. Aug. 30, 1957. 48p. Project title: CERAMIC AND CERMET MATERIALS. Task title: CERAMIC AND CERMET MATERIALS DEVELOPMENT. Contract AF33(616)-2959. (AD-150971).

The reinforcement of 80 Ni-20 Cr alloy by the addition of such refractory oxides as TiO_2 and Al_2O_3 was attempted. Several powder metallurgical fabrication techniques were investigated such as (1) pressing and sintering, (2) pressing and sintering followed by various working procedures, (3) internal oxidation and (4) liquid phase sintering. In the press-sinter method of fabrication, the best stress-rupture characteristics of 1600°F were obtained with additions of 3.0 to 4.5% TiO_2. An addition of 4.5% TiO_2 resulted in a rupture time of 29.6 hours as compared to a rupture time of 1.0 hour obtained on bars containing no TiO_2. Various hot and cold working procedures did not result in any improved stress-rupture properties. The liquid phase sintering technique produced the best stress-rupture properties. Stress-rupture tests at 1800°F showed a stress of 6200 psi for an 80 Ni-20 Cr + 1.0% TiO_2 + C material which was more than three fold better than wrought Nichrome V. Stress-rupture tests on the same materials at 1975°F showed the liquid phase material to have twice the strength of Nichrome V. The impact strengths varied from 10 to more than 50 inch pounds. Room temperature tensile strengths which were fairly consistent, averaged about 75,000 psi. The thermal shock properties were excellent and the oxidation resistance, although not quite as high as Nichrome V, was considered good. (For preceding period see WADC-TR-56-190.) (M.H.R.)

8418 WADC-TR-57-577(Pt. I)

Marquardt Aircraft Co., Van Nuys, Calif.

DEVELOPMENT AND EVALUATION OF INSULATING TYPE CERAMIC COATINGS. PART I. DEVELOPMENT AND SMALL SCALE TESTING. Period covered: May 15, 1956 to June 15, 1957. S. Sklarew, C. A. Hauck, and A. V. Levy. Aug. 15, 1957. 98p. Project title: CERAMIC AND CERMET MATERIALS. Task title: CERAMIC AND CERMET MATERIALS DEVELOPMENT. Contract AF33(616)-2957. (AD-150957).

Eight systems of metal reinforced refractory coatings were investigated. These systems were based on sodium silicate, frit, aluminum phosphate, and borosilicate glass binders with refractory grain fillers, designed to insulate aircraft structural members operating in the thermal range of 2000 to 3000°F. Thermal drops of as high as 10°F per thousandth in. of coating thickness at equilibrium were observed with lag times up to 60 sec to attain equilibrium under laboratory test conditions. (auth)

8419

CRYSTAL HABIT OF ALPHA ALUMINA IN ALUMINA CERAMICS. H. N. Baumann, Jr. (Carborundum Co., Niagara Falls, N. Y.). Am. Ceram. Soc. Bull. 37, 179-84 (1958) Apr.

The predominating crystalline component in alumina ceramics is alpha alumina, and differing physical properties result from variations in its crystal habit and microstructure. These petrographic properties are affected by raw materials, methods of fabrication, heat treatment, and associated chemical compounds. The crystal habit of alpha alumina in alumina ceramics is examined by microscopy and related techniques. (J.R.D.)

8420

SOLID SOLUTIONS IN Al_2O_3–SiO_2 SYSTEM. N. A. Toropov and F. Ya. Galakhov (Inst. of Chemistry of Silicates, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R. Otdel. Khim. Nauk, No. 1, 8-11(1958) Jan. (In Russian)

A constitution diagram was plotted for Al_2O_3–SiO_2 showing the transition temperatures of mullite. The investigation confirmed the congruent character of mullite melting. (R.V.J.)

Corrosion

8421 NAA-SR-74(Del.)

North American Aviation, Inc., Downey, Calif.

CYCLOTRON IRRADIATION OF TYPE 347 STAINLESS STEEL WELDS IN NaK AT ELEVATED TEMPERATURES. A. A. Epp, Jr., R. D. Moeller, and H. Pearlman. Jan. 7, 1953. Decl. with deletions 4/11/57. 42p. Contract AT-11-1-GEN-8. $7.80(ph OTS); $3.30(mf OTS).

Capsules of type 347 stainless steel, containing samples of arc welded 347 immersed in NaK of 78 weight-per cent K, were irradiated with deuterons on the 60 inch cyclotron at Berkeley while maintained near 450°C. Power densities ranging from 2500 to 5000 watts/cm^3 were achieved in the weld samples near the NaK interface. The irradiations were between 10 and 20 hours in length, at average beam currents from 1.5 to 3 micro-amperes. Control runs in which the capsules were heated, but not irradiated, and in which a weld sample was irradiated in an evacuated capsule, were also made. No conclusive evidence was obtained that weld corrosion was accelerated in the irradiate runs, compared with unirradiated controls. In addition to weighing the samples, examining them metallographically for evidence of corrosion and analyzing the NaK chemicall after the runs, observations were also made of surface hardness, grain size and x-ray-diffraction patterns of the weld samples. No significant differences were found between the irradiated and control samples. (auth)

8422 AEC-tr-3199

CORROSION OF STAINLESS STEELS IN SOLUTIONS CONTAINING HYDROFLUORIC ACID. M. M. Kurtepov and A. S. Gryaznova. Translated from Trudy Komissii Bor'be s Korroziei Metal. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk No. 2, 59-68(1956). 7p.

Stainless steels of 18/8 type containing Ti, Mo, Nb, Ti, and Mo, or Mo and Nb were submitted to the action of HF alone and that of HF + HNO_3. The concentration of HF was varied from 0.1 to 10%. HNO_3 was used either as a 10% or

a 30% solution. The tests were run at temperatures varying from 70 to 95°. Corrosion resistance was measured by the loss of weight. The type of corrosion was studied by photomicrographs. In HF the corrosion resistance depends on the concentration and the temperature of the acid for a given steel, but it varies with the composition of the steel. In HNO_3 + HF the general attack is much stronger; it increases with the concentration of HF in the mixture. Intercrystalline corrosion occurs for all alloys susceptible to this type of attack. The intensity in this case depends on the temperature and is specific for each alloy. A solution containing 10% HNO_3 + 1 to 3% HF (or 2% NaF or NH_4F) is proposed as a test solution for intercrystalline corrosion for stainless steel. The results are visible within 6 hr at room temperature and within 1 hr at 70 to 80°. (auth)

8423

CORROSION OF ANODICALLY AND CATHODICALLY POLARIZED MAGNESIUM IN AQUEOUS MEDIA. G. R. Hoey and M. Cohen (National Research Council, Ottawa, Ont., Can.). J. Electrochem. Soc. 105, 245-50(1958) May.

The effect of current density, pH, and temperature on the anodic behavior, cathodic behavior, and corrosion of magnesium in aqueous solutions has been studied. A tentative mechanism for the anodic oxidation of magnesium is postulated. Local corrosion and/or undermining of metallic magnesium at the anode are appreciable and may, in fact, account for the observed low anodic current efficiencies of magnesium. An intergranular type of corrosion occurs at cathodically polarized magnesium at elevated temperatures. A hydrogen embrittlement theory is proposed to explain intergranular cathodic corrosion. (auth)

Geology and Mineralogy

8424 BLG-16

Brussels. Centre d'Etude de l'Énergie Nucléaire.

LES METHODES DE PROSPECTION DE L'URANIUM ET DU THORIUM. (Methods of Prospecting for Uranium and Thorium.) L. Van Wambeke. Nov. 12, 1957. 92p.

The problems connected with the prospecting for fissile materials are discussed in three parts: the geological and geochemical factors in the prospecting for uranium and thorium; radiometric prospecting for uranium and thorium; and geochemical prospecting for uranium and thorium. The report is based on data gathered during studies in the United States and Canada. 238 references. (J.S.R.)

8425 NYO-7414

Pennsylvania State Univ., University Park. Mineral Industries Experiment Station.

AN INVESTIGATION OF THE MINERALOGY, PETROGRAPHY, AND PALEOBOTANY OF URANIUM-BEARING SHALES AND LIGNITES. SCOPE A—SHALES. Quarterly Progress Report [for] Period of April 1, 1956 to June 30, 1956. T. F. Bates, H. D. Wright, E. O. Strahl, F. L. Stanonis, Robert Lester O'Neil, J. D. Grace, and H. D. Duey. June 30, 1956. Includes Appendix: A STUDY OF TRACE ELEMENT DISTRIBUTION IN THE CHATTANOOGA SHALE (thesis). Robert Lester O'Neill. 75p. Project E-32. Contract AT(30-1)-1202. $10.80(ph OTS); $3.90(mf OTS).

The trace elements in 61 samples from the upper Devonian Chattanooga shale and 42 samples from seven shales of Ordovician, Devonian, and Pennsylvanian age were determined spectrochemically. The relationship between carbon and elements that are capable of variable valence states as a result of variation in oxidation–reduction potential was tested statistically. Statistical analysis of the data obtained from these samples shows that in the Chattanooga shale: uranium, molybdenum, nickel, cobalt, germanium, beryllium, lead, and copper increase as carbon increases; manganese and carbonate and carbonate minerals decrease as carbon increases; vanadium and zinc show no significant association with carbon; boron is higher in the lower stratigraphic units of the Chattanooga shale than in the upper units. The analysis of the samples from the Chattanooga shale studied indicates that reducing conditions were of great importance in the concentration of uranium and molybdenum in the black lithologic units of the Chattanooga shale. (auth)

8426 RME-1056

Division of Raw Materials. Denver Exploration Branch, AEC.

PRELIMINARY REPORT ON URANIUM DEPOSITS IN THE WIND RIVER BASIN, WYOMING. Eugene W. Grutt, Jr., Jonathan P. Hadfield, Jr., and Edward W. Smith. With a Section on Mineralogy by Robert G. Coleman. Oct. 4, 1954. 57p. $0.40(OTS).

The uranium deposits, scattered over widely separated areas in the eastern part of the Wind River Basin, are unusual in their mineralogy. Undoubtedly, additional deposits will be found as prospecting becomes more thorough and the coverage more complete. Coarse-grained arkosic sandstones of the Wind River formation are the most favorable host rocks, but, in a well-mineralized area, any formation that has suitable lithologic characteristics may contain ore. The Gas Hills area in the most promising district in the Basin, and most of the prospecting activity has been centered there. Drilling has shown that mineralization extends to depths of more than 100 ft, and deposits of minable grade and tonnage are indicated. No estimate of the importance of structure in localizing these deposits can be given because its role is not fully understood. Fractures, joints, and faults have been noted near ore at several localities. Within this region areas other than the Gas Hills are thought to be promising. It has not been possible to cover these in detail because much additional work remains to be done on them. It is believed that careful geologic, mineralogic, and radiometric observations will establish useful criteria to guide the search for ore bodies, especially those in the Gas Hills area. The Wind River Basin given promise of becoming a uranium producing district of importance. The areal and stratigraphic extent of radiometric anomalies, and of uranium minerals, indicates that thousands of square miles in the Wind River Basin should be prospected. (auth)

8427 RME-1069(Pt. 1(Rev.))

Division of Raw Materials. Denver Exploration Branch, AEC.

DRILLING REPORT, WIND RIVER BASIN PROJECT NO. 1, GAS HILLS AREA, WYOMING. PART 1, REVISED. Jonathan P. Hadfield, Jr. Jan. 1956. 10p.

In January 1954 a drilling program was initiated in and near the Gas Hills of eastern Fremont County, Wyo. The project, which was completed in May 1954, was the first exploratory drilling in the Wind River Basin since the original uranium discovery was reported in the fall of 1953. A total of 158 holes with an aggregate footage of 14,800 feet were drilled to explore ten separate areas for uranium and stratigraphic information. Most of the drilling was limited to the Wind River formation of Eocene age, but a few holes were planned to test the Morrison formation of Jurassic age and the Thermopolis formation of Cretaceous age. Seven areas were barren, and uranium minerals were found only in the coarse, fluviatile strata of the Upper Wind River formation. The deposits contain meta-autunite and earthy yellow uranium phosphates, which occur as interstitial fillings or as pebble and fracture coatings. These minerals are not in radiometric equilibrium. Other uranium phosphates, carbonates, and arsenates are known

to be present. A study of the mineralogy of the deepest ores has not been completed. Rotary, noncore drilling is suitable for general exploration in the Gas Hills area. Future exploration, based on geologic as well as radiometric guides, should be successful. (auth)

8428 RME-2004(Pt. 1)
Division of Raw Materials. Salt Lake Exploration Branch, AEC.
REPORT ON WAGON DRILLING FOR URANIUM IN THE SILVER REEF PHARRISBURG) DISTRICT, WASHINGTON COUNTY, UTAH. Edwin J. Poehlmann and Earl N. King. Dec. 1953. 24p. $0.75(OTS).

An exploratory wagon drilling program was conducted on the Silver Crown, Big Hill, and Silverman claims of Western Gold and Uranium Mines, Inc., at the Silver Reef district near Leeds, Utah. Two economically significant new ore bodies were discovered and considerable geological information gained. The Silver Reef uranium deposits are located near the faulted north-plunging nose of the Virgin anticline in an old silver mining district. Silver, uranium, vanadium, and copper minerals occur in association with various carbonaceous, sandy shale horizons of the Leeds and Tecumseh members of the Triassic Chinle formation. Mineralization has favored areas where relatively close-spaced normal faults of very small displacement cut the favorable beds. (auth)

8429
X-RAY STUDIES OF SYNTHETIC COFFINITE, THORITE AND URANOTHORITES. L. H. Fuchs and Elizabeth Gebert (Argonne National Lab., Lemont, Ill.). Am. Mineralogist 43, 243-8(1958) Mar.-Apr.

X-ray data are presented for synthetic coffinite, thorite, and several uranothorites. The cell constants obtained for coffinite are a = 6.981 ± 0.004 kX, c = 6.250 ± 0.005 kX; for thorite a = 7.128 ± 0.004 kX, c = 6.314 ± 0.003 kX. Intermediate constants determined for several uranothorites indicate a continuous solid solution between $USiO_4$ and $ThSiO_4$. Coffinite and thorite are isostructural with zircon; the space group is D_{4h}^{19}—I_4/a md. The oxygen positions for coffinite are u = 0.180 ± 0.010, v = 0.347 ± 0.010 and for thorite u = 0.166 ± 0.010 v = 0.347 ± 0.010. No changes were observed either in line intensities or in cell constants when (OH) was removed from the hydrothermal preparations. (auth)

8430
FORMATION AND PROPERTIES OF SYNTHETIC THORITE CRYSTALS. L. H. Fuchs (Argonne National Lab., Lemont, Ill.). Am. Mineralogist 43, 367-70(1958) Mar.-Apr.

Crystals of tetragonal thorite up to 1 mm in diameter were grown from a 55 mole % ThF_4–45 mole % $KThF_5$ entectic mixture. The resulting transparent crystals were examined for optical and crystalline properties. X-ray-diffraction data are also reported. (J.E.D.)

8431
URANIUM OCCURRENCE IN BADEN-WÜRTTEMBERG. W. Wimmenauer. Atomwirtschaft 3, 115-18(1958) Mar. (In German)

The results of several geological surveys of the Baden-Württemberg area are summarized. (J.S.R.)

Metals and Metallurgy

8432 AECU-3669
Denver. Univ. Denver Research Inst.
METALLOGRAPHIC INVESTIGATION OF COMMERCIAL ZIRCALOY ALLOYS. Final Report [for] July 1, 1957–December 31, 1957. Frank C. Perkins. 117p. For Westinghouse Electric Corp. Bettis Atomic Power Div. Contract AT-11-1-GEN-14, Subcontract No. 73-(14-3621). $18.30(ph OTS); $6.00(mf OTS).

An investigation is presented of the microstructure of Zircaloy-2 as a function of melting technique, fabrication processing stages, and subsequent heat treatment. Emphasis was concentrated on the distributions and quantities of secondary micro-constituents in relation to the primary phase. In addition to the examination of structures from several fabrication stages of argon- and vacuum-melted Zircaloy-2, specimens of these materials were subjected to a series of isothermal anneals above and below the alpha-beta transformation range and cooled through this range at several rates to determine the effects of the transformation on the structural distributions. (W.L.H.)

8433 AECU-3675
Stanford Research Inst., Menlo Park, Calif.
REACTIONS OF TITANIUM WITH WATER AND AQUEOUS SOLUTIONS. Quarterly Report No. 4 (Report No. 11) [for] December 16, 1957–March 15, 1958. Fred E. Littman and Franklin M. Church. Mar. 15, 1958. 14p. [Oak Ridge National Lab. SRI Project No. SD-2116. For Contract W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

The limits of autoignition of Ti at 300°C were investigated using systems composed of oxygen–steam and oxygen–helium mixtures. The results indicate that the lower limit under these conditions is not appreciably different from that at room temperature. Preliminary experiments have shown that Zr ignites spontaneously if a fresh surface is exposed to sufficiently high concentrations of oxygen. (W.L.H.)

8434 AECU-3682
Bureau of Mines. Div. of Explosives Technology, Pittsburgh.
ZIRCONIUM HAZARDS RESEARCH. Progress Report No. 2 [for] September 1, 1957 to February 28, 1958. J. A. Herickes, P. A. Richardson, M. Weiss, and G. Gelernter. Feb. 28, 1958. 31p. Contract AT(11-1)-473. $4.80(ph OTS); $2.70(mf OTS).

The study of the sensitivity characteristics of Zr samples such as sponge, scrap, foil, and powder was continued. Of particular interest was the determination of the relative sensitivity of these materials to such stimuli as electrostatic discharge and an induced shock wave. The investigation of the zirconium–water reaction and zirconium–gas reactions at relatively low temperatures was continued. (For preceding period see AECU-3554.) (W.L.H.)

8435 AFOSR-TN-58-227
Imperial Coll. of Science and Tech., London. Royal School of Mines.
FIRST ANNUAL REPORT OF RESEARCH ON THE CREEP OF METALS (JANUARY 1958). E. N. da C. Andrade. 25p. Contract AF61(514)-1177. (AD-154129).

Investigations are reported on the mechanism of creep in metals, in particular the way in which different stages in the creep process are governed by the behavior of the crystal grain of which the metal is composed. (W.L.H.)

8436 BNL-3472
Brookhaven National Lab., Upton, N. Y.
FRACTIONAL PRECIPITATION PROCESSES FOR LIQUID METAL FUELS. Robert J. Teitel. [195?]. 21p. $0.75 (OTS).

Several liquid metal fuels based upon U–Bi, U–Pb–Bi, U–Pb–Sn, and U–Pb–Bi–Sn alloy systems have been proposed for reactor design. Experimental data on the distribution of rare earth tracers between precipitated uranium inter-metallic compounds and their liquid phases

are reported and discussed. A complete processing cycle is proposed and tested experimentally for the U–Sn, in Pb–Bi–Sn dispersion fuel systems. (auth)

8437 HW-38019

[General Electric Co. Hanford Atomic Products Operation, Richland, Wash.]

FILLERWELD OPERATION AND MAINTENANCE MANUAL FOR ALUMINUM WELDING. July 1955. Changed from OFFICIAL USE ONLY Mar. 20, 1957. 17p. Contract [W-31-109-Eng-52]. $3.30(ph OTS); $2.40(mf OTS).

Fillerwelding is a fusion welding process that provides for the automatic addition of controlled amounts of filler-wire during inert-gas-shielded tungsten-arc welding. Fillerwelding aluminum jacketed fuel elements has been successfully demonstrated and is being used on a routine basis. This manual was written to provide the necessary information to operate and maintain the fillerweld equipment. (auth)

8438 HW-54932

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

EVALUATION OF WELDED AND SEAMLESS ZIRCONIUM AND ZIRCALOY-2 TUBING. INTERIM REPORT—INITIAL METAL PREPARATION AND SEAMLESS TUBE FABRICATION AND TESTING. S. H. Bush. Feb. 10, 1958. 28p. Contract W-31-109-Eng-52. $4.80(ph OTS); $2.70(mf OTS).

Zirconium alloys have found their principal application as structural and jacket material for reactors. Tube fabrication is discussed for this application. Results reported cover initial metal preparation and fabrication into sheet and billets for conversion into tubing. (A.C.)

8439 KAPL-1880

Knolls Atomic Power Lab., Schenectady, N. Y.

THE ELECTRON METALLOGRAPHY OF SOME ALUMINUM ALLOYS. F. D. Leipziger. Oct. 1957. 9p. Contract W-31-109-Eng-52. $0.50(OTS).

The methods for polishing and replicating aluminum alloy specimens for study with an electron microscope are reported. The three alloys chosen because of their resistance to corrosion in high temperature water were: a 6% copper alloy, a 1% nickel, 1% iron alloy, and a 1% nickel, 0.5% iron alloy. This work involved the examination with an electron microscope of these three alloys, both before and after varying periods of exposure to water at 680°F. The preparation of specimens for microscopic examination is also described. (auth)

8440 LA-2184

Los Alamos Scientific Lab., N. Mex.

THE PREPARATION AND IDENTIFICATION OF $MgBe_{13}$. R. O. Elliott, E. M. Cramer, and F. H. Ellinger. Sept. 1954. 10p. Contract W-7405-eng-36. $0.50(OTS).

The intermetallic compound $MgBe_{13}$ was prepared by two independent methods: (1) by the reduction of beryllium fluoride with liquid magnesium in a flux-protected bath and (2) by the extraction of aluminum from an induction-melted Al–Be alloy by means of successive dilutions of the aluminum-rich phase of this alloy in large quantities of liquid magnesium. The $MgBe_{13}$ prepared by these methods was identified by both metallographic and x-ray diffraction methods. It was found to have the $NaZn_{13}$ type of crystal structure, with a face-centered-cubic lattice, 112 atoms per unit cell, $a_0 = 10.16 \pm 0.01$ A and an x-ray density of 1.79 g/cm^3. (auth)

8441 MAB-130-M

National Research Council. Materials Advisory Board.

UNIFORM TESTING PROCEDURES FOR SHEET MATERIALS. PART 3. COMPRESSION TEST. PART 5. SHEAR TEST. Fourth Report of Task Force on Uniform Procedures for Structural Design Data Collection. Apr. 23, 1958. 15p. Contract DA-36-039-sc-76436.

To provide some basis for uniformity in evaluating high-temperature titanium alloys, a set of procedures for preparing specimens, testing, and data recording are presented for compression and shear testing. (D.E.B.)

8442 MAB-131-M

National Research Council. Materials Advisory Board.

EVALUATION OF HIGH STRENGTH STEELS FOR ELEVATED TEMPERATURE APPLICATIONS IN AIRCRAFT. PART I. FLAT ROLLED PRODUCTS. Apr. 8, 1958. 90p. Contract DA-36-039-sc-76436.

Two questionnaires, prepared by the Materials Advisory Board but distributed by the Aircraft Industries Association, elicited the information that flat rolled steels required today and in the reasonably foreseeable future for airframe applications should preferably be corrosion resisting and have the following short time mechanical properties.

Service Temperature	Minimum Tensile Strength
Room	260,000 psi
800°F	200,000 psi
1000°F	170,000 psi
1100°F or 1200°F	120,000 psi

It was further developed that current methods of presenting creep data are inadequate and that a uniform method of testing new steels for aircraft applications is indicated. All compositions should be readily weldable and have reasonably good machinability consistent with unavoidable high hardness. Steels suitable for high-temperature applications in aircraft and missiles are of six types: hot work steels and martensitic alloy steels, which are not corrosion resisting, and martensitic stainless, semi-austenitic precipitation hardening stainless, cold rolled austenitic stainless and precipitation hardening austenitic stainless steels, all of which have varying degrees of corrosion resistance. Some 27 trade name steels currently in production met one or more of the MAB target values; no one steel met all of them. Of the various steels which met the target values, the hot work steels offer the highest tensile strengths and the best strength/weight ratios up to 1000°F based on short time tensile tests. This superiority in properties may change with long time testing and does not necessarily hold where extended service applications at elevated temperatures occur. Martensitic stainless steels are satisfactory up to about 800°F based on short time data and some of the cold rolled austenitic and semi-austenitic precipitation hardening stainless steels also appear usable to this temperature. At 1100°F, hot work steels and austenitic precipitation hardening stainless grades, both hot rolled or cold reduced, are approximately equal in strength while at 1200°F, the precipitation hardening austenitic stainless steels or iron base alloys are superior. No significant break through of the 1100 to 1150°F top usable service temperature for true steels appears likely in the near future although all of the major producers are conducting active research on the subject. (auth)

8443 NAA-SR-1434

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

DIMENSIONAL CHANGES RESULTING FROM ALPHA-BETA THERMAL CYCLING OF URANIUM AND URANIUM ALLOYS. B. R. Hayward. Mar. 15, 1956. Decl. Feb. 27, 1957. 33p. Contract AT(04-3)-49. $1.00(OTS).

To obtain experimental data on the dimensional changes resulting from temperature excursions into the beta phase in uranium metal fuel slugs, specimens were thermal

cycled above, below, and bracketing the $\alpha-\beta$ phase transformation temperature. Results of variations in the rate of cycling with alpha-rolled, powder-compacted uranium and powder-compacted uranium alloys are described. Although the temperature gradients in these tests do not represent those to be encountered in reactor operation, the results indicate the relative stability of materials and the importance of further investigation of this problem. (auth)

8444 NMI-1196
Nuclear Metals, Inc., Cambridge, Mass.
A PRELIMINARY INVESTIGATION OF THE TENSILE PROPERTIES OF BERYLLIUM COUPLINGS.
J. Greenspan. Dec. 11, 1957. 29p. Contract AT(30-1)-1565. Dep.; $0.75.

Exploratory tensile testing was performed on various types of couplings, including beryllium to beryllium, beryllium to 316 stainless steel, and beryllium to 2S aluminum. It was found that beryllium in bolted or riveted joints was capable of considerable plastic deformation before fracture, but in brazed joints it was not. Beryllium as part of a threaded couple has good tensile strength, but little ductility. (auth)

8445 NMI-1199
Nuclear Metals, Inc., Cambridge, Mass.
ROOM TEMPERATURE DEFORMATION PROCESS IN ZIRCONIUM. E. J. Rapperport. Feb. 24, 1958. 27p. Contract AT(30-1)-1565. Dep.; $0.75(OTS).

A study has been made of the deformation processes active in zirconium deformed in tension and compression at room temperature. The work was performed on single crystals and on large grained samples of relatively high purity. Iodide crystal-bar zirconium was used, with some samples being made from arc-melted stock, and some from the crystal bar as grown. After removal of hydrogen from the zirconium by dynamic vacuum annealing, two methods of crystal production were employed. One method was to maintain the samples at 840°C in vacuo for eight to ten days; the other was to cycle the samples two or three times between 1200 and 840°C, remaining at the higher temperature for about four hours, and at the lower for five days. These techniques yielded grains as large as 0.5 cm × 0.5 cm × 1.8 cm, which were of satisfactory quality, as judged by the sharpness of spots on Laue back reflection photographs. The only slip system observed was $(10\bar{1}0)$ $[\bar{1}2\bar{1}0]$ with a critical resolved shear stress for slip of about 0.65 kg/mm^2 in compression. Although a wide distribution of crystal orientations was used and some crystals were particularly well oriented for basal slip, no slip of this type was observed. The active twin planes were $\{10\bar{1}2\}$, $\{11\bar{2}1\}$, $\{11\bar{2}2\}$, and $\{11\bar{2}3\}$. Experimental determinations were made of the twin elements for $(10\bar{1}2)$, $(11\bar{2}1)$, and $(11\bar{2}2)$ twins. The experimental shear magnitudes found for these three types of twins are about 0.17, 0.21, and 0.23, respectively, and the shear directions for the planes as written above are $[\bar{1}011]$, $[11\bar{2}\bar{6}]$, and $[\bar{1}\bar{1}23]$, respectively. The extreme narrowness (one to two microns) of the $\{11\bar{2}1\}$, twins caused considerable experimental difficulty and as a consequence the twin elements for this family are less certain than for the others. (auth)

8446 NP-6659
Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.
THE USE OF X-RAY DIFFRACTION FOR THE STUDY OF TITANIUM AND TITANIUM ALLOYS. J. R. Doig, Jr. Mar. 5, 1958. 19p.

This memorandum is a condensed, selective collection of information on the application of x-ray diffraction to metallurgical research on titanium alloys. The first part contains suggestions on procedures to be followed to achieve optimum-quality x-ray-diffraction patterns, and the second part contains information collected from the literature on standard or typical x-ray-diffraction patterns. (auth)

8447 NP-6666
Battelle Memorial Inst., Columbus, Ohio.
THE EFFECT OF RHENIUM ON THE FABRICABILITY AND DUCTILITY OF MOLYBDENUM AND TUNGSTEN. R. I. Jaffee and C. T. Sims. Apr. 1, 1958. 40p. Contract Nonr-1512(00).

The favorable effects of rhenium on the hot workability of molybdenum was found to result from the redisposition of oxygen as a complex oxide or molybdate at rhenium contents over about 25 at. % rhenium. The low-temperature ductility of the Mo–25 to 35 Re alloy is much better than that of molybdenum alone as a result of mechanical twinning and reduction of dislocation locking. The effects of rhenium on tungsten were found to be similar, although the improvement in low-temperature ductility is less marked. (auth)

8448 NRL-5127
Naval Research Lab., Washington, D. C.
CRACK PROPAGATION TESTS OF HIGH-STRENGTH SHEET STEELS USING SMALL SPECIMENS. J. E. Srawley and C. D. Beachem. Mar. 7, 1958. 30p.

A test for high-strength sheet materials is described which may serve to provide a means of distinction between materials which could be expected to behave reliably in highly stressed structures and those which would be sensitive to minute stress raisers. The test requires only small specimens, about the size usually used for conventional tests of sheet materials, which are provided with a central transverse crack. The result is expressed as a net fracture stress, which can be compared directly with the conventional tensile strength of the material. The test is limited to those materials which are sensitive to hydrogen embrittlement, but this category includes most materials which have sufficient strength to be eligible for current high-stress applications, and which derive their high strengths from heat treatment rather than strain hardening. It is shown that the test provides a clear distinction between type 410 stainless steel, hardened and tempered to its highest ultimate tensile strength (190 ksi), which exhibits ductile behavior below room temperature, and a modified type 422 stainless steel, hardened and tempered to its highest ultimate tensile (250 ksi), which exhibits brittle behavior well above room temperature. Although the conventional tensile properties of the type 422 steel, including elongation at fracture, are superior to those of the type 410 steel, the net fracture stress of the 410 is equal to its ultimate tensile strength, whereas that of the 422 is less than 0.6 of its ultimate tensile strength at temperatures below a transition temperature of about 250°F. These results refer to materials 40 or 50 mils thick. With decreasing thickness, the net fracture stress of the 422 steel increased; at a thickness of 10 mils it was about 0.8 of the ultimate tensile strength at room temperature. This suggests that if a means could be found for utilizing laminated sheets of many thin layers the higher strength but more brittle materials might be safely used. (auth)

8449 NRL-5140
Naval Research Lab., Washington, D. C.
CAST AGE-HARDENABLE AUSTENITIC STEELS. E. A. Lange, N. C. Howells, and A. Bukowski. Apr. 2, 1958. 16p.

Cr–Ni–P, Cr–Mn, and Cr–Ni–Mn–V types of age-hardenable, austenitic steels which have high strength

characteristics in wrought forms were investigated for use as high-strength, nonmagnetic steels for castings. A Cr–N–P austenitic steel with 0.3% C and 0.25% P developed yield strengths at the 100,000 psi level. The Cr–Mn type of austenitic steels containing phosphorus or vanadium were age hardenable, but castings of these alloys were brittle when they were heat treated to high strength levels. Modifying the wrought Cr–Ni–Mn–V composition resulted in an alloy with good ductility and yield strengths at the 100,000 psi level. A fourth type of age-hardenable, austenitic steel, Mn–V, containing a minimum of alloying elements was developed. The hardness and tensile properties of four compositions which were cast and heat treated to yield strengths at the 100,000 psi level are reported. (auth)

8450 ORNL-2360

Oak Ridge National Lab., Tenn.

PLASTIC STRAIN ABSORPTION AS A CRITERION FOR HIGH TEMPERATURE DESIGN. C. R. Kennedy and D. A. Douglas. May 2, 1958. 25p. Contract W-7405-eng-26. $1.00(OTS).

The development of isothermal strain reversal data as an aid to high-temperature design is proposed. A test apparatus capable of mechanically cycling a specimen in tension and compression within set strain limits is described. Data are presented which confirm Coffin's theory that total plastic strain per cycle can be used to predict the number of cycles to failure. Evidence that Inconel strain weakens at the test temperature is noted and grain size is found to be the most important variable affecting the behavior of materials subjected to strain reversals. (auth)

8451 AEC-tr-3198

NEW METHOD OF CONTROLLING WELDED JOINTS OF A STEAM PIPE OF AUSTENITIC STEEL. M. R. Gubanova and V. P. Pushkin. Translated from Energo-Mashinostroenie 3, 22-5(1957). 12p.

A description is given of an experiment on the development of a method of productive control of welded joints of steam pipe with the aid of ultrasonics. The problem of the ultrasonic control of the welded joints of a steam pipe was successfully solved, due to the comparatively small thickness of the welded seam of the steam pipe and to a development of a specialized defectoscope. However, these results cannot give exhaustive data on the possibility of controlling austenitic welded joint of other types. (auth)

8452 AEC-tr-3207

THE SOLUBILITY OF THORIUM IN LIQUID ZINC. M. V. Smirnov, N. G. Ilyushchenko, S. P. Detkov, and L. E. Ivanovskii. Translated by Lydia Venters from Zhur. Fiz. Khim. 31, 1013-18(1957). 11p.

This paper was previously abstracted from the original language and appears in NSA, Volume 11, as abstract No. 11241.

8453 AEC-tr-3214

ON RELATIONSHIPS OF THE DIFFUSION AND LATTICE REORGANIZATION PROCESS DURING THE DECOMPOSITION OF SOLID SOLUTIONS. Yu. A. Bagaryatzkii (Bagaryatzkij) and Yu. D. Tyapkin. Translated by S. J. Rothman from Doklady Akad. Nauk S.S.S.R. 115, 1111-14 (1957). 6p.

For the particular case of the decomposition of a supersaturated solid solution, two opposite points of view exist: The lattice is rearranged first with a subsequent change of constitution due to diffusion and the reverse. The results on the decomposition of supersaturated solid solutions of Ti in Ni and nichrome appear to favor the second hypothesis. The first hypothesis is clearly the correct one for a special class of transformation, martensitic transformation. (W.L.H.)

8454 AEC-tr-3215

OXIDATION OF TITANIUM. Per Kofstad and Karl Hauffe. Translated from Werkstoffe u. Korrosion 7, 642-9(1956). 19p.

Experimental data on the oxidation of Ti exhibit considerable discrepancies, particularly in the high-temperature range >800°C. The varying results are shown in the different rates of oxidation, the time laws, and consequently also in the activation energies of oxidation. On the basis of these facts, a critical survey of previous investigations was made to compare these data with experimental results obtained by the authors and to coördinate all the various findings. (J.E.D.)

8455

RHENIUM BORIDES. V. S. Neshpor, Yu. B. Paderno, and G. V. Samsonov. Doklady Akad. Nauk S.S.S.R. 118, 515-16(1958). (In Russian)

The phase compositions of the rhenium–boron systems Re_4B, Re_2B, Re_3B_2, ReB, Re_3B_4, Re_2B_4, Re_2B_3, ReB_2, and Re_2B_5 were studied. (R.V.J.)

8456

STUDY OF THE KINETICS OF THE SINTERING OF TITANIUM BY THE DILATOMETER METHOD. R. S. Mints. Doklady Akad. Nauk S.S.S.R. 118, 543-5(1958). (In Russian)

8457

MACHINING NONFERROUS METALS. Iron Age 181, No. 17, 113-28(1958) Apr. 24.

Machining practice as it applies to aluminum, magnesium, copper, copper-base alloys, and titanium is discussed. Detailed information is provided on machine operations, proper tooling, speeds and feeds, depth of cut, lubricants, and coolants. (W.D.M.)

8458

A NOTE ON ALUMINIUM-RICH ALUMINIUM–MANGANESE–COPPER–NICKEL ALLOYS. G. V. Raynor and C. R. Faulkner (Univ. of Birmingham, Eng.). J. Inst. Metals 86, 323-4(1958) Mar.

Metallographic examination of slowly cooled alloys and of alloys annealed for long periods at 500°C indicates that the ternary compounds $Ni_4Mn_{11}Al_{60}$ and $Cu_2Mn_3Al_{20}$ form a complete series of solid solutions in the quaternary system aluminum–manganese–copper–nickel. (auth)

8459

CONSTITUTIONAL FACTORS AFFECTING THE TENSILE PROPERTIES OF WROUGHT ALUMINIUM–MAGNESIUM–SILICON–COPPER ALLOYS. D. L. W. Collins (Aluminium Labs., Ltd., Banbury, Eng.). J. Inst. Metals 86, 325-36 (1958) Mar.

The tensile properties of solution-treated and artificially aged alloys within the composition range 0.5 to 2.0% magnesium, 0.3 to 1.2% silicon, and 0 to 1.5% copper, have been investigated, and related to equilibrium reactions at the heat-treatment temperatures. An isotherm for the aluminum–magnesium–silicon–copper system at 520°C has been derived from published information, together with some original work. A close correlation was found between the mechanical properties and constitution, in particular the solid-solution composition when quenched. The effects of magnesium + silicon and of copper were found to be largely independent, the properties of an alloy with a given copper content being represented approximately by the properties of the ternary aluminum–magnesium–silicon alloy with the same magnesium + silicon content, plus an increase depending on the copper addition; alloys in which

the strength was mainly attributable to copper were more ductile than those depending on magnesium and silicon. (auth)

8460

EFFECT OF TITANIUM ON THE TENDENCY OF STAINLESS STEEL CONTAINING 18% Cr AND 9% Ni to UNDERGO INTER-CRYSTALLITE CORROSION. Cihal Vladimir and Pospisil Rudolf. Huntnicke listy 11, No. 5, 284-90(1956). (Translated from Referat. Zhur. Khim. No. 2, 1958, abstract no. 6859)

Investigation of the effect of maintaining stainless steels of the 18-8 type, stabilized with Ti, in the range of 550 to 700 after cooling down from excessively high temperatures has revealed that at high temperatures TiC begins to dissolve. At 650° separation takes place from the oversaturated solid solution of a chromium carbide of the type $(CrFe)_{23}C_6$, and the steel shows a tendency to intercrystallite corrosion (IC). If Ti content exceeds the theoretical amount required to bind the C, the amount of ferrite increases in such steels, and at temperatures somewhat below 800° the ferrite undergoes transformation into the G-phase. Rate of reversed separation of the thermodynamically more stable TiC is regulated by the slower rate of diffusion of Ti as compared with that of Cr. This takes place at more elevated temperatures. The greater the ratio of Ti to C, in the steel, and the less the steel is overheated at high temperatures, the less TiC is dissolved in the solid solution, and accordingly, the chromium carbide particles formed within the dangerous temperature range do not form a continuous network at the boundaries of the grains. Steel having the composition (in %): C, 0.08; Mn, 1.18; Si, 0.88; Cr, 18.24; Ni, 9.25; Mo, 0.21; Ti, 0.80; and N, 0.003, hardened at 1350° and held at 550° shows thereafter a tendency to IC, which is associated with separation of carbides of chromium at grain boundaries. Stabilizing annealing at 850 to 950°, resulting in separation of fine particles of TiC, precludes the tendency of steel to undergo IC. (auth)

8461

ULTRASONIC WELDING—A NEW TECHNIQUE GROWS. J. Byron Jones (Aeroprojects, Inc., West Chester, Penna.). Metal Progr. 73, No. 4, 68-72(1958) Apr.

Ultrasonic welding unites similar or dissimilar metals by introducing vibrational energy into the area to be joined. Solid-state metallurgical bonds, comparable in strength to those resulting from conventional methods, are produced. Thin gages, even in high-temperature, corrosion-resistant metals, are readily welded. (auth)

8462

STRESS-FREE NICKEL PLATING. Metal Progr. 73, No. 4, 90-2(1958) Apr.

Nickel in stress-free condition or with compressive stress can be plated from a sulfamate bath. It is finding a number of engineering applications on parts plated to improve fatigue life and minimize fretting and wear, and in electroforming to avoid distortion. It holds promise for improved high-temperature coatings for missiles and rockets. (auth)

8463

TEAR TEST FOR TITANIUM SHEET. C. W. Vigor and J. R. Hornaday, Jr. (General Motors Corp., Detroit). Metal Progr. 73, No. 4, 103-6(1958) Apr.

Small coupons are torn by a conventional tensile testing machine. The amount and duration of applied force are recorded and used to determine the work required for tearing. Resulting data measure effect of hydrogen embrittlement, and thermal instability. (auth)

8464

ALLOYS OF TITANIUM AND ZIRCONIUM CONTAINING TIN. R. F. Smart (Tin Research Inst.). Metallurgia 57, 181-8(1958) Apr.

Tin is an important alloying element in titanium and zirconium, especially in those alloys designed for creep and corrosion resistance. A review is presented of the effect of tin on titanium and zirconium, and of the properties of alloys of those metals containing tin. (auth)

8465

ANOMALY IN THE AGE-HARDENING BEHAVIOUR OF ALUMINIUM–ZINC ALLOYS. N. Gane and R. N. Parkins (Univ. of Durham, Newcastle upon Tyne, Eng.). Nature 181, 1198-9(1958) Apr. 26.

The very rapid hardening which occurs at room temperature after solution treatment in aluminum alloys containing about 10% zinc has been considered to be caused by a mechanism similar to that which accounts for the hardening of aluminum–copper alloys aged at higher temperatures. However, recent work has suggested that this explanation is not valid—the extent of hardening is temperature dependent; the hardness rises to a maximum and does not decrease; an alloy aged to maximum hardness at room temperature shows only a very slow decrease of hardness on subsequent aging at 100°C; as the temperature is increased, the hardness increase becomes less; and with solutions other than zinc there is no difficulty in following the precipitation accompanying hardening. (J.S.R.)

8466

INSTALLATION FOR METAL ETCHING BY MEANS OF ION BOMBARDMENT. G. V. Spivak, V. Ye. Yurasova, F. F. Kushnir, and I. N. Prilezhayeva. Pribory i Tek. Ekspt. No. 2, 106-10(1957).

Cathode sputtering has been widely applied to structural investigation of metals, alloys, and dielectrics. An installation for metal etching which allows plating at high temperatures is described. The temperature may be varied from 100 to 700°C. The installation permits good control of the etching and plating processes and a rapid change from one operation to another. (J.S.R.)

8467

TUNGSTEN-ARC WELDING OF 0.002-IN. AND 0.005-IN. STAINLESS STEEL AND TITANIUM. Jay C. Collins and S. P. Jenkins (Convair, Fort Worth, Texas). Welding J. (N. Y.) 37, 342-7(1958) Apr.

The cover of The Welding Journal is 0.005 in. thick. That is just right for a magazine cover but pretty slim from the standpoint of welding the same thickness of 17–7 PH stainless-steel sheet. To complicate matters, this weld must be made without the use of a filler rod because of aerodynamic requirements. In addition, the weld-bead reinforcement must be held to −0.001 in. or +0.003 in. tolerance for the 72-in. lengths required, and the 1.1% aluminum content of the base metal must be retained to achieve the required maximum heat-treat response. Prior to this assignment, 0.015 in. was considered to be the ultimate in thin-gage welding. These welds are used as exterior skins for the brazed honeycomb panels that go into the construction of Convair's B-58 supersonic bomber. (auth)

8468

NEW FORGE WELDING OF ALUMINUM AND MAGNESIUM ALLOYS. L. A. Cook and D. G. Shafer (Ravens-Metal Products, Inc., Parkersburg, W. Va.). Welding J. (N. Y.) 37, 348-58(1958) Apr.

A new forge-welding process for welding high-strength aluminum and magnesium alloys has been developed. This forge welding consists of heating the parts to be welded to a

temperature which is high enough to allow good uniform flow of the materials without cracking and yet the temperature is sufficiently low that the samples are not overaged or partially annealed in the welding process. Careful control of the time, temperature and pressure cycles are important. Welds made in high-strength aluminum alloys and high-strength magnesium alloys by this forge process have developed 95 to 100% joint efficiencies. For example, welds in 7075-T6 aluminum alloy have been made which possess an ultimate tensile strength in excess of 80,000 psi with an elongation of 5 to 6%. Similar results were obtained in such magnesium alloys as ZK60A-T5, with joint strengths in excess of 50,000 psi and elongations of 11%. Successful welds were also made between high-strength aluminum alloys and high-strength magnesium alloys to produce joint strengths of 95 to 100%. Metallographic examination of a range of forge-welded high-strength aluminum and magnesium alloys indicates high-quality welds of similar metallurgical characteristics to those obtained in cold welding and flash-butt welding. Many of the major defects normally attributed to these other welds are not apparent in this new forge-welding process. Based on the experience to date with this new forge-welding process, it is expected that other alloys and alloy systems can be welded to obtain similar high joint efficiencies. It is anticipated that this process will be widely used in the future for many new products where welding has previously presented a major problem. (auth)

8469

SPOT WELDING OF Ti–6Al–4V ALLOY. R. K. Nolen, J. F. Rudy, and H. Schwartzbart (Armour Research Foundation, Chicago) and H. D. Kessler (Titanium Metals Corp. of America, Toronto, Ohio). Welding J. (N. Y.) 37, 129s-37s(1958) Apr.

A procedure for spot welding Ti–6Al–4V was developed by performing a systematic variation of weld parameters and machine settings and measuring the mechanical properties of the welds obtained. The resulting data were found to be comparable to recommendations for similar gages of stainless steel. Having developed a welding schedule that produced satisfactory spot welds, the optimum machine settings obtained were used to study other geometrical effects such as minimum contacting overlap, shunting current, minimum spot weld spacing and electrode indentation. A secondary phase, discussed in this paper, is concerned with a preliminary investigation of post-weld heat treatments to determine their effects on the cross-tension to tension-shear strength ratios of the as-welded joints. The data indicate that these ratios are increased slightly by employing post-weld heat treatments in the machine or heating with an oxyacetylene flame. Data are also presented on the elevated-temperature strength of spot welds, and the effects of exposure to air at elevated temperatures under load or no load on room-temperature strength. (auth)

8470

EFFECT OF HEAT TREATMENT ON THE MICROSTRUCTURE AND LOW-TEMPERATURE PROPERTIES OF PRESSURE-VESSEL STEELS. J. H. Gross, E. H. Kottcamp, and R. D. Stout (Lehigh Univ., Bethlehem, Penna.). Welding J. (N. Y.) 37, 160s-8s(1958) Apr.

This paper describes the effects produced by new heat-treating techniques currently employed on heavy-section pressure-vessel steels to improve their low-temperature properties. Conventional normalizing treatments produce inferior notch toughness in plates of 2–4 in. and over because of the retarded cooling rate. Micro-structurally, this results in excessive ferrite grain and pearlite aggregate size in plain-carbon steels and increased amounts of higher-temperature transformation products in low-alloy high-strength steels. This problem is minimized by the use of liquid quenching. Quenching, in turn, produces a problem of variable cooling rate, microstructure and properties through the thickness of the plate. Plates of seven low-alloy steels and two carbon steels were heat treated to reproduce the cooling rates at the surface and center of water-sprayed and of normalized 4-in. plate. It was found possible to improve the strength and particularly the notch toughness of the alloy steels by accelerated cooling, provided only that stress relieving followed the treatment. (auth)

8471

HEAT EFFECTS DURING MELTING IN THE SYSTEM LEAD–TIN–BISMUTH. I. THE EQUILIBRIUM DIAGRAM OF THE TERNARY SYSTEM LEAD–TIN–BISMUTH. R. B. Gershman. Zhur. Anal. Khim. 13, 12-18(1958). (In Russian)

Data are presented on the heats of melting and the temperature dependence of the specific heat in the region of separation for 48 alloys of the ternary system lead–tin–bismuth. The temperature dependence of the specific heats of alloys of different concentrations and the concentration dependence of the heats of transition through the eutectic and peritectic planes were used to construct equilibrium diagrams for the system lead–tin–bismuth. (tr-auth)

8472

ON THE MECHANISM OF STAINLESS STEEL CORROSION IN NARROW SLITS AND CREVICES. I. K. Marshakov and I. K. Rosenfel'd. Zhur. Anal. Khim. 13, 66-72(1958). (In Russian)

A study has been made of the corrosion and electrochemical behavior in narrow slits and crevices in 0.5 N NaCl solutions of the various steels. Steel with a 13 to 17% chromium content has been found to lose its passivity in narrow slits and crevices and to undergo considerable pitting corrosion. The corrosion of the stainless steel in the crevice in contact with that in the bulk of the electrolyte increases greatly owing to the formation of active-passive cells, the anode of which is the metal in the crevice. The function of such macrocouples has been studied and the cause of their appearance has been indicated. (tr-auth)

8473

FORMATION OF PHOSPHATE FILMS OF ALUMINUM AND CHROMIUM ON ALUMINUM AND ITS ALLOYS. I. V. Krotov, V. V. Grinina, and N. A. Zapol'skaya. Zhur. Priklad. Khim. 31, 33-40(1958) Feb. (In Russian)

Thermographic and chemical analysis of deactivated aluminum powders and aluminum alloys showed that $CrPO_4$, $AlPO_4$, and water are the main constituents of the phosphate film; the percentages of these components were determined. (R.V.J.)

Tracer Applications

8474 NP-tr-67

INVESTIGATION OF THE FLOW OF GROUND WATERS BY MEANS OF RADIOACTIVE ISOTOPES AND TRACING IONS. Ede Vessey and Gyozo Czerny. Translated from Hidrol. Közlöny 37, 44-56(1957). 27p.

The determination of the speed and direction of flow of ground waters is very important for underground constructions. Several methods are known for the determination of the flow vector. Of these the methods using radioactive isotopes and tracer ions are described, together with the experiments carried out by the authors. The use of tracer ions is new, and it is hoped that this method will be extensively employed in the future. (auth)

8475

DEPOSITION OF RADIOACTIVE FILMS FOR DIFFUSION STUDIES BY MEANS OF THE VACUUM EVAPORATION METHOD. V. I. Izvekov. Pribory i Tek. Ekspt. No. 2, 111-12(1957).

An apparatus used in the investigation of the diffusion of Fe^{59} in the lattices of magnetite, corundum, and rutile is described. It consists of a specially shaped molybdenum glass flask with a tungsten evaporator inside a glass cylinder at the lower spherical part of which is placed the oxide sample with the deposited radioactive metal layer. The iron is deposited on a tungsten filament from a concentrated solution of ferric chloride. The cathode is a loop 4 mm in diameter made of 0.5 mm wire. The method of radioactive layer deposition may be applied for the diffusion analysis of any solid and gives good and consistent results. (J.S.R.)

8476

SOME RESULTS OF THE INVESTIGATION OF KILN PROCESSES OBTAINED WITH RADIOACTIVE ISOTOPES. F. G. Banit. Tsement No. 4, 10-15(1957).

In order to improve the burning process in rotary kilns equipped with built-in filters and pre-heaters, radioactive level-meters were used. Observations have shown that fluctuations in the flow of slurry were due to thermic conditions within the drying zone. Experiments were conducted in the NIZHNIY TAGIL plant with radioactive isotopes, to establish the speed of movement of slurry in different sections of rotary kilns. The tests were conducted with the isotope Fe^{59} in compound with Fe_2O_3, which radiates hard γ rays with energies of 1.1 and 1.3 Mev. It was established during the studies that the speed varied in different sections of the kiln as a result of the retarding actions of the chains, and the changing properties of the slurry in the course of the drying process. (T.C.O.)

PHYSICS

8477 AERE-HP/M-55

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

ATMOSPHERIC DIFFUSION FROM ELEVATED SOURCES. NOTE ON A SYMPOSIUM HELD AT A.E.R.E. HARWELL ON NOVEMBER 26, 1952. F. Pasquill. Aug. 11, 1953. Decl. Jan. 13, 1958. 3p.

The papers presented at the symposium are briefly summarized. (W.L.H.)

8478 BRL-956

Ballistic Research Labs., Aberdeen Proving Ground, Md.

SCIENTIFIC OBJECTIVES AND OBSERVING METHODS FOR A MINIMUM ARTIFICIAL EARTH SATELLITE. L. G. deBey, W. W. Berning, D. Reuyl, and H. M. Cobb. Oct 1955. 165p. DA Project No. 5B0306011.

The problems of systematic and accurate observations of a proposed minimum earth satellite were studied. Limitations imposed by scientific objectives of a satellite vehicle, size of the vehicle, kinds of orbits possible, existing instrumentation technology and the suitability of instrumentation sites were considered. It is concluded that a combination of optical and electronic observing methods is required to satisfy the program objectives. Moreover, such a combination appears to be compatible with the imposed limitations. Included are a number of appendices giving details on the quantitative information appearing in the text, as well as supporting information for extension of the various analyses where desired by the reader. (auth)

8479 HW-53504 A

[General Electric Co. Hanford Atomic Products Operation. Richland, Wash.]

DESIGNING WITH LOGIC FUNCTIONS. A. A. Maupin, Jr. Jan. 17, 1958. 22p. Contract [W-31-109-Eng-52]. $4.80(ph OTS); $2.70(mf OTS).

The functions of relays were studied and found to consist of only five basic principles named logic functions. Combinations of these functions can be used to represent any task historically performed by relays. Static switching devices are manufactured to perform each of these five logic functions and therefore can replace relays. The use of logic functions provides a straightforward method of designing switching circuits and is a much more simple and accurate method than intuitive design or trial and error. An example is presented to illustrate the use of logic functions in control circuit design. (auth)

8480 IGR-TN/S-791

United Kingdom Atomic Energy Authority. Industrial Group. Springfields Works, Springfields, England.

ON THE DUCTILITY OF POLYCRYSTALLINE BERYLLIUM. J. F. W. Bishop. Feb. 1958. 13p.

The elongation to failure of single and polycrystalline specimens of beryllium is markedly correlated with crystal and grain orientations, varying from virtually zero to tens of percent. The available evidence on the deformation of beryllium is reviewed. It is suggested that the anomalous ductility of the metal under time independent straining conditions can be rationalized on the basis of the great resistance to compressive deformation normal to the basal plane offered by the crystals at temperatures below 700°C. From this analysis it appears that directional ductility can in principle be induced in the metal to meet specific requirements. Suggestions for experimental work to examine the validity of the analysis are given. (auth)

8481 NACA-TN-4047

Ames Aeronautical Lab., Moffett Field, Calif.

A STUDY OF THE MOTION AND AERODYNAMIC HEATING OF MISSILES ENTERING THE EARTH'S ATMOSPHERE AT HIGH SUPERSONIC SPEEDS. H. Julian Allen and A. J. Eggers, Jr. Oct. 1957. 61p.

A simplified analysis of the velocity and deceleration history of missiles entering the earth's atmosphere at high supersonic speeds is presented. The results of this motion analysis are employed to indicate means available to the designer for minimizing aerodynamic heating. The heating problem considered involves not only the total heat transferred to a missile by convection, but also the maximum average and local time rates of convective heat transfer. (auth)

8482 NACA-TN-4095

Lewis Flight Propulsion Lab., Cleveland.

AN ANALYSIS OF THE EFFECT OF SEVERAL PARAMETERS ON THE STABILITY OF AN AIR-LUBRICATED HYDROSTATIC THRUST BEARING. William H. Roudebush. Oct. 1957. 34p.

Equations are developed for the motion of a gas-lubricated hydrostatic thrust bearing, and solutions are obtained on a digital computer for air as the gas. Systematic investigations are made of various parameters to determine their effect on bearing stability. Bearing pad volume and rigidity appear as prime controlling factors. (auth)

8483 NACA-TN-4265

Lewis Flight Propulsion Lab., Cleveland.

COMPOSITION AND THERMODYNAMIC PROPERTIES OF

AIR IN CHEMICAL EQUILIBRIUM. W. E. Moeckel and Kenneth C. Weston. Apr. 1958. 39p.

Charts have been prepared relating the thermodynamic properties of air in chemical equilibrium for temperatures to 15,000°K and for pressures from 10^{-5} to 10^{+4} atmospheres. Also included are charts showing the composition of air, the isentropic exponent, and the speed of sound. These charts are based on thermodynamic data calculated by the National Bureau of Standards. (auth)

8484 NACA-TN-4267
Lewis Flight Propulsion Lab., Cleveland.
PRELIMINARY SURVEY OF PROPULSION USING CHEMICAL ENERGY STORED IN THE UPPER ATMOSPHERE. Lionel V. Baldwin and Perry L. Blackshear. May 1958. 74p.

Ramjet cycles that use the chemical energy of dissociated oxygen for propulsion in the ionosphere are presented. After a review of the properties and compositions of the upper atmosphere, the external drag, recombination kinetics, and aerodynamic-heating problems of an orbiting ramjet are analyzed. The study indicates that the recombination ramjet might be useful for sustaining a satellite at an altitude of about 60 miles. Atmospheric composition and recombination-rate coefficients were too uncertain for more definite conclusions. The ramjet is a marginal device even in the optimistic view. (auth)

8485 NYO-3723
Princeton Univ., N. J. Project Matterhorn.
MINIMIZATION OF FLUX LOSS NEAR THE JUNCTION OF A SEMI-INFINITE STRAIGHT COIL WITH A TOROIDAL COIL. Technical Memorandum No. 10. William A. Newcomb. Oct. 21, 1953. 9p. Contract AT(30-1)-1238. $1.80(ph OTS); $1.80(mf OTS).

Equations are developed which show that flux-loss may be minimized by properly displacing the magnet coils parallel to themselves. Displacement values are calculated as a function of distance along the tube, X, for values from 0 to 8 in.; using a tube with inside diameter = 1.5 in., outside diameter = 3.364 in., radius = 1 in., and curvature = 10 in. (D.E.B.)

8486 RIB-13
David Sarnoff Research Center, Princeton, N. J.
ELECTRONIC DEVICES FOR NUCLEAR PHYSICS. Quarterly Report No. 23 [for] February 1, 1956–April 30, 1956. M. H. Greenblatt, R. M. Matheson, A. H. Sommer, and G. O. Fowler. June 15, 1956. (This report also covers work on photoelectric emission which is not included in the contract, and was done by: W. E. Spicer and A. H. Sommer). 29p. [For Oak Ridge National Lab.] Contract W-7405-eng-26, Subcontract 308. $0.25(OTS).

Work on multi-alkali cathode multipliers was continued. Activation of the photocathode is reproducible but improved performance is required. Additional work was directed toward improving the gain of silver-magnesium dynodes and developing a satisfactory activation process for antimony dynodes. Preliminary results are reported from studies of the band structure exhibited by alkali antimonide compounds. The design of a photomultiplier structure with improved time resolution is reported. Efforts to improve the time spread between the photocathode and first dynode in the Type 6810 photomultiplier are discussed. Transient time spread measurements on the DuMont type multiplier were completed. A high voltage supply was built which simplifies photomultiplier testing where potential changes on individual dynodes are desired. (For preceding period see AECU-3164.) (D.E.B.)

8487 SCTM-11-58(14)
Sandia Corp., Albuquerque, N. Mex.
THEORY OF INVERTED L-ANTENNA WITH IMAGE. C. W. Harrison, Jr. Apr. 8, 1958. 31p. Contract AT(29-1)-789. $6.30(ph OTS); $3.00(mf OTS).

An approximate theory of an inverted L-antenna with image is developed, the principal objective being the evolvement of a formula for the driving point impedance of the structure. Using this result it is possible to solve several related antenna problems through employment of the principle of superposition of circuits. Examples of antennas amenable to analysis in this way include the top-loaded folded monopole and the electrically similar hairpin structure. (auth)

8488 SCTM-37-58(14)
Sandia Corp., Albuquerque, N. Mex.
ANTENNA SYNTHESIS. Charles W. Harrison, Jr. Mar. 10, 1958. 22p. Contract AT(29-1)-789. $4.80(ph OTS); $2.70(mf OTS).

The principle of superposition of circuits is utilized to obtain formulas for the driving-point impedance of several antennas that may be synthesized from an inverted L-antenna with image and appropriate open-wire transmission line sections. These structures include a vertically oriented folded monopole with horizontal top loading, and the electrically similar hairpin (or bent folded unipole) antenna. Both of these radiators enjoy wide usage as missile telemetry antennas. The impedance of a folded monopole with vertical top loading (or shunt-excited antenna) is obtained in terms of the impedance of a symmetrical center-driven antenna of discontinuous radius and a suitable line section. (auth)

8489 SCTM-102-58(12)
Sandia Corp., Albuquerque, N. Mex.
OZALID-PHOTO-CHEMICAL METHOD OF PRODUCING PRINTED WIRING BOARDS. H. L. Hawk. Mar. 21, 1958. 6p. Contract AT(29-1)-789. $1.80(ph OTS); $1.80(mf OTS).

A simple and low-cost process for producing printed wiring circuits for the laboratory is described. (auth)

8490 SCTM-134-58(51)
Sandia Corp., Albuquerque, N. Mex.
THE MEASUREMENT OF REMANENT MAGNETIZATION. R. W. Kulterman. Apr. 15, 1958. 19p. Contract AT(29-1)-789. $3.30(ph OTS); $2.40(mf OTS).

A technique for measuring the remanent magnetization of a large number of toroidal samples of ferromagnetic materials is described. Since the cores are to be used in a single-shot pulse application, the measurement is a pulse technique. The cores are driven from a static remanent condition to saturation by a single pulse of current (amplitude 100 amp., rise time 40 μsec). The flux change in the core is measured by integrating the output voltage of a sensing winding. Both mechanical and electrical methods of integrating are described. The measurement can be carried out with a small number of driving and sensing turns wound on the core (1 to 20 per winding). (auth)

8491 TID-3071
Franklin Inst. Labs. for Research and Development, Philadelphia.
A BIBLIOGRAPHY OF DIFFUSION OF GASES, LIQUIDS AND SOLIDS IN SOLIDS, 1890 TO 1955. Frank E. Jaumot, Jr. 315p. Contract AT(30-1)-1484. $3.50(OTS).

The bibliography is divided into six major categories: books and monographs, theory and general discussion including review articles, techniques, one component liquid, gases in solids, and solids in solids. Within the smallest subdivision, the articles are listed by date of publication, and for a given year, alphabetically by author. An author index is provided at the end of the bibliography. (W.D.M.)

8492 UCRL-8093
California. Univ., Berkeley. Radiation Lab.
VOLUMETRIC AND THERMODYNAMIC PROPERTIES OF

NORMAL FLUIDS. Kenneth S. Pitzer. Jan. 1958. 44p. Contract W-7405-eng-48. $1.25(OTS).

A comprehensive system for the prediction of the volumetric and thermodynamic properties of normal fluids has been developed and published in several journal articles. The various tables and equations for this system are presented. Written in the form of an Appendix to a forthcoming revision of the book, Thermodynamics, First Edition, by G. N. Lewis and M. Randall, occasionally reference is made to equations in the main text. (auth)

8493 UCRL-8152

California. Univ., Berkeley. Radiation Lab.

A METHOD FOR ESTIMATING THE HEAT OF FORMATION OF INORGANIC COMPOUNDS (thesis). Howard W. Anderson. Jan. 1958. 55p. Contract W-7405-eng-48. $1.50(OTS).

In thermochemical calculations, it is frequently necessary to estimate the standard heat of formation of compounds for which experimental data are unavailable. Although there are several methods that may be used, none is completely reliable or general. It was the purpose of this research to develop a more reliable and/or more general method of estimation. To do this several modifications were made to the work done by Linus Pauling in developing a scale of electronegativity. The result is a simple equation, $-\Delta H_f = \nu_{AB}(x_B - x_A)^2 + \nu_A Y_A + \nu_B Y_B$, where ν_{AB} is the apparent number of single bonds, ν_A is the number of atoms A in the mole, and ν_B is the number of atoms B in the mole, with a set of parameters x and Y. Each valence state of each element may be assigned a value x and a value Y. Where these parameters have not been determined, they may be calculated for any cation when experimental heats of formation of two compounds of the cation are known. The equation applies primarily to metallic halides, although it may also be used (with reservation) for other anions, including carbonates, sulfates, and similar radicals. It is not restricted to binary compounds. The average deviation obtained for a set of the halides of twenty-two metals was 0.93 kcal/mole. An error of less than 10 kcal/mole may generally be expected in estimating an unknown using only two experimental data. (auth)

8494 WASH-746

Ballistic Research Labs., Aberdeen Proving Ground, Md.

THE RESPONSE OF ELASTIC SPHERICAL SHELLS TO SPHERICALLY SYMMETRIC INTERNAL BLAST LOADING. Wilfred E. Baker and Frank J. Allen. Nov. 1957. 33p. Sponsored by AEC under DA Project No. 5B03-04-002. (BRL-Memo-1113). $1.25(OTS).

Results are presented from an analytical study of the reaction of an idealized nuclear reactor containment shell to internal transient loading which could be caused by reactor runaway. The containment shell is assumed to be an elastic hollow sphere, and the transient loading is assumed spherically symmetric. A general theory of the response, valid for shells of any thickness, is developed. The theory is approximated for thin shells, and compared with experiment. The experiments corroborate the theoretical predictions. (auth)

8495 AEC-tr-3189

CONTEMPORARY PROBLEMS IN THE USE OF ULTRASOUND. III. ULTRASONIC MICROSCOPE. S. Va. Sokolov. Translated from Uspekhi Fiz. Nauk 40, 20-7 (1950). 7p.

In connection with successfully developing ultra acoustics and obtaining very short ultrasonic waves, the author discusses the possibility of making an ultrasonic microscope with which it will be possible to see the image of objects found in both transparent as well as non-transparent media. (A.C.)

8496 AEC-tr-3211

SELF DIFFUSION IN SELENIUM. B. I. Boltax and B. T. Plachenov. Translated by S. J. Rothman from Zhur. Tekh. Fiz. 27, 2229(1957). 3p.

Data on the diffusion and self-diffusion processes in amorphous and crystalline selenium are presented. The processes were found useful for the solution of technological problems connected with the preparation of semiconductor apparatus as well as for studies of the physicochemical properties of selenium. (J.E.D.)

8497

SPIN-DISORDER EFFECTS IN THE ELECTRICAL RESISTIVITIES OF METALS AND ALLOYS. B. R. Coles (Imperial Coll., London). Advances in Phys. 7, 40-71 (1958) Jan.

The most straightforward examples of magnetic behavior associated with localized electrons in metals are provided by the rare earth metals Gd, Dy, and Er, where the 4f electron shell is incomplete. The susceptibilities of these elements at high temperatures show magnetic ordering effects of both ferro- and antiferromagnetic character to be taking place. The electrical resistivity of transition metal alloys has been measured over a considerable temperature range and the high temperature resistivity explained in the light of the spin-disorder scattering term. The use of resistivity measurements to examine the electronic structures is demonstrated. (W.D.M.)

8498

THE CHANGE OF CARRIER CONCENTRATION IN THE GRAPHITE WITH STATIC MAGNETIC FIELD. Yasutada Uemura and Masaharu Inoue (Univ. of Tokyo). J. Phys. Soc. Japan 13, 382-8(1958) Apr.

The change of carrier concentration with a static magnetic field in a single crystal of graphite is considered, and the Hall coefficient R is discussed from this point of view. The Wallace's model of the two-dimensional zone and its orbital quantization proposed by McClure are the starting points of the analysis. By comparison with Kinchin's experiment it is proposed that acceptor levels exist at 11×10^{-3} ev above the bottom of the conduction band and their concentration is 1.7×10^{18}/c.c. Wallace's resonance integral γ_0 is estimated as 1.43 ev semiempirically. The ratio of the mobilities of two carriers $b = \mu_p/\mu_n = 0.87$ gives the best fit of R at the low temperature under the strong magnetic field. By using these resonable values of the parameters the Hall coefficient R is plotted as the function of temperature and magnetic field. The agreement with experimental data is good except in the low field region. The origins of discrepancy are discussed. (auth)

8499

THE MAGNETIC SUSCEPTIBILITY AND ELECTRICAL RESISTIVITY OF SOME TRANSITION METAL SILICIDES. D. A. Robins (General Electric Co., Ltd., Wembley, Eng.). Phil. Mag. (8) 3, 313-27(1958) Apr.

Sintered samples were prepared of a number of silicides formed by the Groups IVa, Va, and VIa transition metals and silicon. Magnetic susceptibility measurements were made at room temperature and 500°C and the electrical resistivity and temperature coefficient of resistivity determined for the range 20 to 120°C. The results are discussed in relation to the type of bonding present in these compounds and it is shown that the transition metal silicides are essentially metallic in character. (auth)

8500

DIFFUSION OF IRON, COBALT, AND NICKEL IN SINGLE CRYSTALS OF PURE COPPER. C. A. Mackliet (Univ. of Ill., Urbana). Phys. Rev. 109, 1964-70(1958) Mar. 15.

The rates of diffusion of radioactive tracers of Fe, Co,

and Ni in single crystals of pure copper have been measured as a function of temperature from about 700 to 1075°C. The results, obtained by the tracer-sectioning technique, are as follows: $D_{Fe\rightarrow Cu} = 1.4 \exp(-51{,}800/RT)$; $D_{Co\rightarrow Cu} = 193 \exp(-54{,}100/RT)$; $D_{Ni\rightarrow Cu} = 2.7 \exp(-56{,}500/RT)$; all in units of cm^2/sec. An exploratory measurement for a Mn tracer in copper was made at 1069°C with the result $D = 1.49 \times 10^{-8}$ cm^2/sec. The results of several current theoretical calculations are compared with the present data: Wert and Zener's correlation of D_0 and Q is supported by the present work; the basic qualitative prediction of Lazarus' screening theory is borne out by the present results, although the extent of the detailed agreement is not clear at this time. The experimental data yielded unexpectedly large diffusion coefficients at low temperatures in some cases and several possible causes are considered. Finally, a new experimental method is described for determining diffusion coefficients with tracers emitting only very low-energy particles. (auth)

8501

SPECIFIC HEAT OF He^3 BELOW 1°K. D. F. Brewer, A. K. Sreedhar, H. C. Kramers, and J. G. Daunt (Ohio State Univ., Columbus). Phys. Rev. 110, 282-4(1958) Apr. 1.

An adiabatic calorimeter of volume 0.5 cm^3 was used which was cooled below 0°K by a paramagnetic salt, the thermal connections being made through a superconducting Pb thermal valve which could be opened and closed magnetically. A 100 ohm manganin heater was used and temperatures were determined by susceptibility measurements of a cesium–magnesium specimen thermally attached to the calorimeter. Results of the measurements of pure He^3 under a pressure of 12 to 15 cm of Hg are shown graphically. The smooth curve falls close to previous results down to 0.25°K. Below this temperature it continues to diminish smoothly with decreasing temperatures down to 0.085°K. The curve appears to allow a linear extrapolation down to 0°K to be made with a slope of 3.75 cal/mol-deg^2. (A.C.)

8502

INTERACTION BETWEEN GRAVITATIONAL-CAPILLARY AND MAGNETOHYDRODYNAMIC WAVES. M. F. Shirokov (Moscow Aviation Inst.). Soviet Phys. JETP. 6, 50-4(1958) Jan.

The uniqueness theorem is proved for the solutions of the hydrodynamic equations for an incompressible strongly conducting ideal liquid. Walen's exact solution for the case in which gravitational and capillary forces act on the liquid is shown to be valid. Relations for the stability conditions, penetration depth etc. are derived for potential and vortex harmonic waves. In the case of potential motion of the liquid the current density in the surface layer is found to be exactly zero. (auth)

8503

MAGNETORESISTIVE PHENOMENA IN n-Ge TYPE SEMICONDUCTORS IN STRONG MAGNETIC FIELDS. M. I. Klinger and P. I. Voroniuk (Chernovtsy State Univ., Semiconductor Inst., Academy of Sciences, USSR). Soviet Phys. JETP. 6, 59-66(1958) Jan.

The equilibrium electron concentration, Hall constant, and electrical resistance of n-Ge type semiconductors in a strong magnetic field are considered. The dependence of these quantities on the field strength is determined. It is found that the quantities under consideration are anisotropic, the nature of this anisotropy being determined by the anisotropy of the electron mass and by the number and mutual arrangement of the constant-energy ellipsoids. (auth)

8504

DENSITY OF He^3–He^4 SOLUTION. T. P. Ptukha (Inst. of Problems in Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. 34, 33-8(1958) Jan. (In Russian)

The temperature dependence of the density of He^3–He^4 solutions subjected to the pressure of saturated vapor was measured at He^3 concentrations of 10, 20.1, 30.3, 41.2, 49.9, 68.5, and 85.4%. The λ-point temperatures for concentrations of 10, 20.1, 30.3, and 41.2% were estimated on basis of the break in the ρ(T) curve. (tr-auth)

8505

RADIATION CORRECTIONS TO BREMSSTRAHLUNG. P. I. Fomin (Kharkov State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 34, 227-8(1958) Jan. (In Russian)

Aerosols

8506 SC-4153(TR)

Sandia Corp., Albuquerque, N. Mex.

DISPERSAL OF FALLOUT BY MEANS OF A HEAT SOURCE. Kenneth L. Shipley. Mar. 1958. 20p. Contract [AT(29-1)-789]. $3.30(ph OTS); $2.40(mf OTS).

The possibility of using heat sources to dissipate fallout from a vital area is considered. A theoretical approach to the problem gives minimum values for number and strength of heat sources required. The problem was further investigated with the aid of a small-scale experiment. The general conclusion is that this method of fallout protection is not feasible. (auth)

Astrophysics

8507

ON A FEATURE OF GALACTIC RADIO EMISSION. Harriet Tunmer (Cavendish Lab., Cambridge, Eng.). Phil. Mag. (8) 3, 370-6(1958) Apr.

Observations of the intensity distribution of radio emission showed a bright belt approximately normal to the galactic plane and passing through the anti-center. An explanation is suggested in terms of the highly anisotropic radiation from relativistic electrons moving in the magnetic field of the local spiral arm. This suggestion avoids the supposition that the sun is in a special position in the galaxy. (auth)

Cosmic Radiation

Refer also to abstract 8243.

8508 IFA-EM-31

Academia R. P. R. Institutul de Fizică Atomică, Bucharest.

CONCERNING THE NATURE OF THE STAR GENERATING COMPONENT OF COSMIC RAYS. (Privitor la Natura Componentei Generatoare de Stele a Razelor Cosmice.) C. Bercea. 1956. 6p.

Prior to 1949, the generation of low-energy reactions in cosmic radiation was attributed to low-energy nucleons existing in great numbers in the atmosphere. Attempts to prove the existence of unstable particles in the generating components had been fruitless. Belovitzky et al. (Doklady Akad. Nauk S.S.S.R. 69, 321(1949)) using the well known compensation method obtained the first evidence for the existence of the unstable particles in the star-generating component without establishing the nature of these particles. They pointed out that the observed decay effect can be interpreted in two ways: (1) the particles generating the

stars are unstable and the decay effect is produced directly by them and (2) the particles generating the stars are stable but are produced in the atmosphere by a component containing unstable particles. Belovitzky et al. considered the first hypothesis as the most plausible one. In the present paper the results of the above reference are analyzed using the second variant of the decay effect. It is concluded that the second hypothesis cannot explain the observed decay effect. (A.C.)

8509 IFA-EM-35

Academia R. P. R. Institutul de Fizică Atomică, Bucharest.

ON A POSSIBLE MODEL FOR THE NUCLEON CASCADE AT MODERATE ENERGIES. (Despre un Model Posibil Pentru Procesul Nuclear de Cascadă la Energii Mijlocii.) E. M. Friedländer and E. Ruckenstein. 1956. 7p.

An attempt is made to explain the known facts concerning the development of the nucleon cascade in air on the assumption that the secondary active particle is either a nucleon or a (π) meson. The nucleon cascade in air was investigated under the assumption of the following model: The meson showers contain Δ secondary active particles (Δ = const) which carry away a fraction β of the incident E (β = const). At moderate energies $\Delta \lesssim \perp$. This secondary particle has a probability g of being a charged π meson. The total number of produced mesons increases with E according to a power law ($\sim E^{g}$). The number α of fast recoil nucleons is independent of energy. The interaction cross-section is constant and equal to the geometric one. Ionization losses of fast charged particles may be neglected. The energy spectrum is of the form $E^{-5}\,dE/E$. (auth)

8510

A SURVEY OF THE COSMIC-RAY NUCLEONIC COMPONENT ALONG 145° EAST LONGITUDE USING AN AIRBORNE MONITOR. J. R. Storey, A. G. Fenton, and K. G. McCracken (Univ. of Tasmania, Hobart). Nature 181, 1155-6(1958) Apr. 19.

A survey of the cosmic-ray nucleonic component was made between the longitude limits 140°E and 148°E. A two-counter neutron monitor installed in an airplane was employed, with separate electronic circuits provided for each counter and the scaled counts accumulated on registers and recorded individually on a pen recorder. Intensity became independent of latitude above 43.5°S on the longitude 148°E. A preliminary account is presented of results obtained. Discrepancies between the observed distribution of cosmic ray intensity over the surface of the Earth and that expected from conventional geomagnetic theory are discussed. (C.H.)

8511

OBSERVATIONS ON EXTENSIVE AIR SHOWERS. V. THE SIZE SPECTRUM OF SHOWERS CONTAINING $3 \times 10^6 - 3 \times 10^8$ PARTICLES. T. E. Cranshaw, J. de Beer, W. Galbraith, and N. A. Porter (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8) 3, 377-83(1958) Apr.

A lattice arrangement of G.M. counters was used to measure the size spectrum of showers containing 3×10^6 to 3×10^8 particles. In this region, a power law distribution is found. $J(\geq N) = 9.5 \times 10^{-5}(10^6/N)^{1.88 \pm 0.15}\ m^{-2}\ hr^{-1}\ ster^{-1}$. An independent method of measuring the number of particles in the showers gave good agreement with these figures. (auth)

8512

STARS AS SOURCES OF COSMIC RAYS. Horace Babcock (California Inst. of Tech., Pasadena). Phys. Rev. 109, 2210-11(1958) Mar. 15.

Numerous type A stars have recently been listed having coherent magnetic fields with intensities ranging up to a few thousand gauss. More numerous are type A stars showing pronounced Doppler line broadening due to axial rotation but small Zeeman displacements in polarized light. A discussion of the data leads to the view that all A stars, with the exception of a few slow rotators, have strong magnetic fields. It appears that strong stellar fields result from a regenerative process, requiring turbulent motion of the stellar material in the presence of rotation. Observations show that virtually all stellar magnetic fields vary and that the great majority fluctuate irregularly. Some years ago it was recognized that the fluctuation of magnetic fields of stars might be sources of cosmic rays. In view of the present evidence that nearly all A stars have strong fluctuating magnetic fields and of the likelihood that weaker fluctuating fields of mixed polarity are common among stars in general, the contention that stars are important sources of cosmic rays must be taken seriously. The general magnetic fields of many A type stars are stronger than the field of the sun by a factor of 10^3; their fluctuations are large and rapid. Under these conditions, there is general agreement that induction processes and hydromagnetic shock waves will occur that are capable of exciting a portion of the ions present to very high energies. The energies for particle acceleration by fluctuating plasmas in stellar atmospheres must be derived from turbulent motion. (A.C.)

8513

ON THE STRUCTURE OF EXTENSIVE AIR SHOWERS. Akira Ueda and Naofumi Ogita (Kyoto Univ. and Kinki Univ., Osaka). Progr. Theoret. Phys. (Kyoto) 18, 269-86(1957) Sept.

Assuming a simple model of extremely high-energy collisions, the relation between the one-dimensional development of extensive air showers (EAS) and the mechanism of multiple meson production is investigated. The gross structure of EAS based on the model is given graphically or numerically, in a form useful, as a first step for further investigations. In particular, varying the value of inelasticity of high energy collisions, its effect on various quantities is discussed. As a preliminary conclusion it is shown that it seems difficult to explain the experimental result of the constancy of the attenuation length of the electron component over a wide range of primary energies, $10^{14} \sim 10^{17}$ev, without introducing any energy dependence of the inelasticity or a stronger energy dependence of multiplicity with increasing energy, though it is desirable that further experiments provide more abundant and reliable data. Attention is also paid to the problem of what quantities must be measured to determine more directly and less ambiguously the angular and energy distributions of secondary particles produced by high-energy collisions. (auth)

8514

ON THE PRODUCTION OF MESONS IN HYDROGEN AND CARBON ABOVE 10 Gev. II. Y. Watase and S. Mitani (Osaka City Univ.) and K. Suga and Y. Tanaka (Univ. of Tokyo). Progr. Theoret. Phys. (Kyoto) 18, 314-18(1957) Sept.

Continuing a study on the production of mesons in hydrogen and carbon, a cloud chamber which contained alternate layers of paraffin, graphite, and lead was operated with a counter hodoscope system at Mt. Norikura (elevation 2840 m) Cosmic-Ray Laboratory, University of Tokyo. Energy distributions of photons originating from neutral pions produced by nuclear interactions in paraffin, graphite, and lead were compared. The results are summarized in tables and graphs. (A.C.)

8515
AN UNUSUAL COSMIC RAY BURST. A. I. Kuz'min, G. V. Skrypin, G. V. Tianutova, and Iu. G. Shafer. Soviet Phys. (Doklady) 1, 263-5(1956) May-June.

This paper was previously abstracted from the original language and appears in NSA, Vol. 10, as abstract No. 11263.

8516
POSITIVE HYPERON AND SINGLY CHARGED HYPER-FRAGMENT DECAYS. V. V. Alpers, I. I. Gurevich, and A. P. Mishakova. Soviet Phys. (Doklady) 1, 272-5(1956) May-June.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 522.

8517
OBSERVATION OF THE PRODUCTION AND DECAY OF UNSTABLE PARTICLES IN AN EMULSION CHAMBER. V. V. Alpers, I. I. Gurevich, and L. V. Surkova. Soviet Phys. (Doklady) 1, 310-11(1956) May-June.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 1258.

8518
THE LARGE COSMIC RAY BURST OF FEBRUARY 23, 1956 AS OBSERVED AT MOSCOW, SVERDLOVSK, TBILISI AND CAPE SCHMIDT. L. I. Dorman, N. S. Kaminer, V. K. Koiava, and B. F. Shvartsman (Terrestrial Magnetism Research, Inst., Sverdlovsk Geophysical Observatory, Tbilisi Cosmic Ray Station, and Cape Schmidt Cosmic Ray Station). Soviet Phys. (Doklady) 1, 364-6(1956) May-June.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 1198.

8519
ON THE PRODUCTION OF THE ELECTRON-PHOTON COMPONENT IN THE INTERACTION OF COSMIC-RAY PARTICLES OF ENERGIES GREATER THAN 10^{11} ev WITH BERYLLIUM NUCLEI. L. T. Baradzei, V. I. Rubtsov, Iu. A. Smorodin, M. V. Solov'ev, B. V. Tolkachev, and Z. I. Tulinova (P. N. Lebedev Physics Inst., Academy of Sciences, USSR). Soviet Phys. JETP. 6, 12-15(1958) Jan.

Four events of electron-nuclear showers produced by cosmic-ray particles of energy exceeding 10^{11} ev interacting with beryllium nuclei in a cloud chamber are discussed. The energy transferred to π^0 mesons in the interactions is determined. Large fluctuations in the π^0 meson energy were observed. One of the photographs is an example of an interaction in which π^0 mesons are apparently not generated. (auth)

8520
INCONSISTENCY BETWEEN THE THEORETICAL AND EXPERIMENTAL DELTA-SHOWER FREQUENCIES AT HIGH ENERGIES. P. S. Chikin (Moscow State Univ.). Soviet Phys. JETP. 6, 41-3(1958) Jan.

Experimental data on the frequency of high-energy δ-electron production are tabulated. Calculation of the frequency of small underground ionization bursts is carried out. All the data point to a contradiction between theory and experiment at energies $\geq 5 \times 10^8$ ev. (auth)

8521
ENERGY SPECTRUM OF CASCADE ELECTRONS IN LIGHT MATERIALS. I. P. Ivanenko (Moscow State Univ.). Soviet Phys. JETP. 6, 105-7(1958) Jan.

The energy spectrum of cascade electrons in showers produced by a primary electron or photon in light substances has been computed. A brief analysis of the numerical results is given. (auth)

8522
ON INTERPRETATION OF THE LATERAL DISTRIBUTION OF NUCLEAR-ACTIVE PARTICLES IN EXTENSIVE AIR SHOWERS. Iu. N. Vavilov (P. N. Lebedev Physics Inst., Academy of Sciences, USSR). Soviet Phys. JETP. 6, 141-4 (1958) Jan.

Experimental data referring to the shape of the lateral distribution curve of nuclear-active particles near the axis of extensive showers are considered. The data indicate a small value of the averaged minimum angles of emission of nuclear-active particles responsible for generation of the nuclear-active particles directly recorded in the experiments ($<4 \times 10^{-3}$ radians). It is shown that Landau's theory of multiple particle production can yield such a small value for the emission angle only if it simultaneously predicts a high degree of concentration of energy of the incident particle on a single secondary particle in an elementary act of the nuclear cascade process at energies of 10^{12} to 10^{15} ev. (auth)

8523
ANALYSIS OF THE PROPERTIES OF THE ELECTRON-PHOTON COMPONENT OF EXTENSIVE AIR SHOWERS IN THE LOWER THIRD OF THE ATMOSPHERE. V. I. Zatsepin (P. N. Lebedev Physics Inst., Academy of Sciences, USSR). Soviet Phys. JETP. 6, 150-4(1958) Jan.

It is concluded from an analysis of the experimental data that in the absence of large fluctuations in the longitudinal development of extensive air showers the energy spectrum in the region $E \lesssim 10^9$ ev and in the lower third of the atmosphere satisfies the condition $1.3 \geq s \geq 1.2$ (if electrons in equilibrium with μ-mesons are subtracted), s being the parameter of the electromagnetic cascade theory, which characterizes the electron energy spectrum. For a spectrum of the indicated type the lateral distribution of electrons at distances from 1.5 to 250 m from the shower axis can be explained completely by multiple Coulomb scattering. (auth)

8524
HYDRODYNAMICAL INTERPRETATION OF ONE CHARACTERISTIC OF LARGE SHOWERS RECORDED IN PHOTOGRAPHIC EMULSIONS. G. A. Milekhin and I. L. Rozenthal' (P. N. Lebedev Physics Inst., Academy of Sciences, USSR). Soviet Phys. JETP. 6, 154-6(1958) Jan.

The experimental distribution of the transverse momentum components of secondary particles is compared with the predictions of the hydrodynamical theory of multiple particle production. It is found that the predictions of the one-dimensional theory for a final temperature of $T_{fin} = mc^2/k$ (where m is the π-meson mass) agree satisfactorily with the experimental data. This permits us to draw some conclusions concerning the nature of $\pi-\pi$ interaction. (auth)

8525
PROBABILITY FOR CHARGE EXCHANGE IN NUCLEONS WITH ENERGIES OF $3 \times 10^9 - 10$ ev IN INTERACTIONS WITH AIR NUCLEI. V. A. Vorobiev (Inst. for Applied Geology, Academy of Sciences, USSR). Soviet Phys. JETP. 6, 203-4(1958) Jan.

In the investigation of nuclear-cascade showers in cosmic rays, many investigators have concluded that in the interaction of high energy nucleons (several Bev and higher) with air nuclei, the main part of the energy (about 70%) in the stars which are produced is carried off by one of the emitted nucleons which in turn also produces stars. In the present article, the dependence of the charge of this nucleon on the charge of the incoming nucleon is examined. From results of photoemulsion experiments and calculations of the ratio of the number of stars produced by neutrons and multiply charged particles to the number of stars produced by protons the preliminary conclusion is that the probability of charge exchange is 0.7 to 0.8 rather than the usually assumed value of 0.5. (J.S.R.)

8526
SOFT COMPONENT IN AN ELECTRON-NUCLEAR SHOWER AT ENERGIES OF 10^{14} ev. I. M. Gramenitskii, G. B. Zhdanov, M. I. Trem'iakova, and M. N. Shcherbakova (P. N. Lebedev Physics Inst., Academy of Sciences, USSR). Soviet Phys. JETP. 6, 218-19(1958) Jan.

The electron-photon component in Ilford G-5 emulsions exposed at a height of 25.5 km was developed over a region of two cascade lengths. The results of the study are given in the form of a space-energy distribution of the non-bremsstrahlung electron-positron pairs and an electron space distribution. An analysis of the data leads to the conclusions that the total number of photons is approximately equal to the number of penetrating particles emitted within the forward cone; the energy flux carried by the photons is approximately 0.1 of the energy of one nucleon of the primary particle, and twice the mean energy carried by one photon is approximately equal to the mean energy of one penetrating particle if it is assumed that the mean energy associated with the transverse momentum component of the mesons is 1.5 μc; and the concentration of photons and associated energy flux close to the axis of the shower is considerably higher than that which would be expected on the basis of the angular distribution measurements and the transverse momentum of the penetrating particle of the shower. (J.S.R.)

8527
CLOUD CHAMBER INVESTIGATION OF THE NUCLEAR-ACTIVE COMPONENT OF ATMOSPHERIC SHOWERS. I. A. Ivanovskaya, L. I. Sarycheva, and P. S. Chikin (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 34, 45-52(1958) Jan. (In Russian)

Nuclear processes induced by particles of extensive air showers were studied with the help of a cloud chamber containing 7 lead plates. The spatial distribution of nuclear-active particles in extensive showers as well as the nature and energy spectrum of the particles were determined. (tr-auth)

8528
TWO INCIDENTS OF HYPERFRAGMENT DECAY. Kh. P. Bebayan, N. M. Marutyan, K. A. Matevosyan, and M. G. Rostomyan (Inst. of Physics). Zhur. Eksptl'. i Teoret. Fiz. 34, 231-2(1958) Jan.

Observations made on an emulsion layer bombarded in the stratosphere revealed an incident of heavy hyperfragment decay with the emission of energetic protons (the hyperfragment was interpreted as F_Λ or Ne_Λ) and an incident of mesonic hyperfragment decay. The hyperfragment decayed into three charged particles. An analysis of the $F_\Lambda^{18,19,20}$ and $Ne_\Lambda^{20,21}$ decay schemes is given. In the second incident a π-meson track with an energy of 32.8 ± 5.0 Mev was observed, and the kinematic analysis of the scheme was $He^5 \rightarrow p + \pi^- + He^4 + Q$, and $Li^{7,8} \rightarrow p + \pi^- + Li^{6,7} + Q_2$, where $Q_1 = Q_2 = (39.0 \pm 5.0)$ Mev. (R.V.J.)

Crystallography and Crystal Structure

8529 NP-6616
Eagle-Picher Research Labs. Mining and Smelting Div., Miami, Okla.
RESEARCH ON GROWING OF CADMIUM SULFIDE CRYSTALS FOR DOSIMETER PURPOSES. Quarterly Report No. 2 for period July 17, 1957 to October 17, 1957. J. E. Powderly and K. E. Bean—W. E. Medcalf, ed. 51p. DA Project No. 3-99-00-100. Contract DA-36-039-SC-73270.

Progress is reported in the development of a method of growing cadmium sulfide crystals with properties suitable for their incorporation into an electrically simple direct current instrument for measuring nuclear radiations. Fourteen runs were carried out during the period which resulted in production of single crystals of cadmium sulfide. Studies were made on the effects of crystal purity, doping materials, infra-red quenching, crystal size and homogeneity, and light and dark resistivities of the crystals on the sensitivity of the crystals to gamma rays. (For preceding period see NP-6451.) (C.H.)

8530 SCL-T-179
ON THE TRIBOLUMINESCENCE OF CRYSTALS. (Über die Tribolumineszenz von Kristallen.) G. Wolff. Translated by M. I. Weinreich from Proc. Intern. Symposium on Reactivity of Solids. Gothenburg, 1952, Pt. 1, 253-61 (Pub. 1954). 9p.

Triboluminescence (TL) has its cause in the splitting of crystal surface elements. It is possible to prove that TL can arise only when it is possible to produce differences in potential and thereby discharges between crystal fracture surfaces and ions, or atom recombinations of them. Both types of luminosity processes can take place either separately or juxtaposed; i.e., TL may hence represent discharge luminosity and/or recombination luminosity. Crystals of equal structure (NaCl, Calcite, Wurtzite, et al.) display permanent TL if one among them is triboluminescent. The Tl increases as the polarizability decreases in the individual charge carriers of the crystals. If the constituents of the crystals are not charged carriers in themselves (ions, polarized bond partners in principal valence lattices), then they must at least behave as dipoles or contain polar substitutes, if TL is to occur at all. (auth)

8531
PLASTIC DEFORMATION OF NICKEL SINGLE CRYSTALS AT LOW TEMPERATURES. Peter Haasen (Univ. of Chicago and Max-Planck-Institut fuer Metallforschung, Stuttgart). Phil. Mag. (8) 3, 384-418(1958) Apr.

Single crystals of nickel (purities 99.98% and 99.4%) were deformed in tension at various temperatures between 4.2 and 300°K. Shear stress–shear strain relations were determined as well as the reversible change of flow stress with temperature. The work-hardening parameters obtained are discussed in terms of dislocation theory developed mainly on the basis of data on Al and Cu. From the temperature dependence of the stress at the beginning of dynamical recovery the activation energy of cross-slip is estimated to be slightly lower than that of copper, implying a somewhat higher stacking fault energy. The advantages of the temperature change method for an investigation of the flow stress are pointed out following a theoretical analysis of the relation between this method and that of the work-hardening parameters. The present results on nickel confirm this relation. Metallographic and x-ray evidence was obtained in favor of deformation twinning in nickel at 4.2 and 20°K although no drop in load was observed of the kind found in copper. Serrations in the recorded load-extension curves indicate discontinuous flow at the lowest temperatures. (auth)

8532
SEMICONDUCTING PROPERTIES OF Mg_2Si SINGLE CRYSTALS. R. G. Morris, R. D. Redin, and G. C. Danielson (Iowa State Coll., Ames). Phys. Rev. 109, 1909-15 (1958) Mar. 15.

High-purity n-type single crystals of the semiconducting compound Mg_2Si were prepared from melts of stoichiometric proportions of the constituents in graphite crucibles; p-type crystals were obtained when the melt was doped with silver or copper. Carrier concentrations in the saturation region were as low as 8×10^{16} cm^{-3} for n-type and 4×10^{17} cm^{-3} for p-type samples. Electrical resistivity ρ and Hall

coefficient R were measured from 77 to 1000°K. Hall mobility R/ρ showed a temperature dependence in the intrinsic range of approximately $T^{-3/2}$ for all samples. At 300°K, R/ρ was as high as 406 cm^2/volt-sec for n-type and 56 cm^2/volt-sec for p-type material. The ratio of electron mobility to hole mobility was approximately five. The energy gap, determined from the least-square slopes at high temperature of the curves $\log(RT^{3/2})$ vs. $1/T$, was 0.78 ev. The electron mobility at any temperature in the range 77 to 400°K can be explained quantitatively by a combination of scattering by optical modes and scattering by ionized impurities. (auth)

8533

SEMICONDUCTING PROPERTIES OF Mg_2Ge SINGLE CRYSTALS. R. D. Redin, R. G. Morris, and G. C. Danielson (Iowa State Coll., Ames). Phys. Rev. 109, 1916-20 (1958) Mar. 15.

Single crystals of Mg_2Ge have been obtained from melts of the constituents, and Hall effect and electrical resistivity measurements have been made from 77 to 1000°K. Undoped crystals were n-type and had saturated impurity carrier concentration as low as 3×10^{15} cm^{-3}; silver-doped crystals were p-type and had saturated impurity carrier concentrations roughly proportional to the amount of added silver. The room-temperature Hall mobilities were observed to be 280 cm^2/volt-sec for electrons and 110 cm^2/volt-sec for holes. The hole mobility observed in the extrinsic region (120 to 350°K) of the highest purity p-type sample and the mobility difference observed in the intrinsic region (350 to 700°K) of the n-type samples varied with temperature as $T^{-2.0}$. The mobility difference was found to decrease faster than $T^{2.0}$ above 700°K. The width of the energy gap at absolute zero, as determined from the temperature dependence of both the resistivity and the Hall effect in the intrinsic region, was 0.69 ± 0.01 ev. (auth)

8534

POST-BOMBARDMENT CONDUCTIVITY IN MgO CRYSTALS. R. A. Shatas, J. F. Marshall, and M. A. Pomerantz (Franklin Inst., Swarthmore, Penna.). Phys. Rev. 109, 1953-8(1958) Mar. 15.

Electrical conductivity following the termination of bombardment by 1.3-Mev electrons has been observed in MgO crystals. Depending upon the rate of decay, one of two different techniques is utilized to determine the time constants at various temperatures. Short time constants at high temperatures are measured oscillographically, whereas long time constants at low temperatures are determined by a dc method. In the former case, a single exponential function fits the crystal current vs. time data, whereas in the latter, a departure occurs. This is accounted for by the theoretical analysis which provides a procedure for determining the relevant time constant. The post-bombardment time constant, τ, changes with temperature in accordance with the relationship $\tau = \tau_0 \exp(E/kt)$ where τ_0 is essentially constant, and E = 1.4 ev. The experimental results are interpreted in terms of a theoretical model involving shallow and deep traps. Thermal re-emission of charge carriers from the former, constituting a single level, occurs following bombardment. A second level in addition to that at 1.4 ev was determined at 0.7 ev by an extension of the technique. The former very likely corresponds to the 2.1-ev optical transition observed previously, in which case the charge carriers involved in this thermal process are holes. (auth)

8535

OPTICAL VIBRATIONS IN CRYSTALS PRODUCED BY SLOW NEUTRONS. V. F. Turchin. Zhur. Eksptl'. i Teoret. Fiz. 34, 219-20(1958) Jan. (In Russian)

In cases where the neutron travels faster than the velocity of sound and falls on the crystal at the Bragg angle, the reflected beam possesses only elastically scattered neutrons and neutrons scattered on optical vibrations (but not acoustic ones). The excitation of longitudinal optical vibrations in a NaCl crystal was used as an example. (R.V.J.)

Electrical Discharge

8536

A NEW PROBE METHOD FOR MEASURING IONIZED GASES. Takayoshi Okuda and Kenzo Yamamoto (Nagoya Univ., Japan). J. Phys. Soc. Japan 13, 411-18(1958) Apr.

A new probe method is proposed. This method is based upon the idea that the end of a cylindrical probe affects the surface area of the sheath. The first stage of this method is to measure the sheath radius by using a variable-length structure. The procedure is to extrapolate the probe current to $l = 0$ along the straight line of the plot of current vs. length of probe and to measure the slope of the straight line and thus to derive the radius of the sheath. Experimental results of ion sheath for Ar are fairly well consistent with the theoretical radius expected from simple theories, except for low plasma density. The discrepancy between the theory and the experiment is caused by the disturbance. By taking into account a correction factor, namely, depletion in ion collection due to elastic scattering, plasma density can be exactly estimated by measuring the radius of ion sheath without having any knowledge of the adequate space charge equation. Thus, the reliability of the probe method is increased. (auth)

8537

ON THE SUBSIDIARY CONDITIONS IN THE BOHM-PINES THEORY OF ELECTRON PLASMA. Hideo Kanazawa (Univ. of Tokyo). Progr. Theoret. Phys. (Kyoto) 18, 287-94(1957) Sept.

The subsidiary conditions in the Bohm-Pines theory are too stringent. There is no normalizable wave function which satisfies the subsidiary conditions. The subsidiary conditions are modified, and it is shown that the mathematical inconsistency in the Bohm-Pines theory may be removed. (auth)

8538

ELECTRODYNAMIC ACCELERATION OF PLASMA BUNCHES. L. A. Artsimovich, S. Iu. Luk'ianov, I. M. Podgornyi, and S. A. Chuvatin (Inst. of Atomic Energy). Soviet Phys. JETP. 6, 1-5(1958) Jan.

An electrodynamic method of accelerating plasma bunches is proposed. The results of preliminary experiments are described. The data obtained are in qualitative agreement with the elementary theory of the phenomenon. (auth)

8539

ON THE DYNAMICS OF A BOUNDED PLASMA IN AN EXTERNAL FIELD. L. M. Kovrizhnykh (P. N. Lebedev Physics Inst., Academy of Sciences, USSR). Soviet Phys. JETP. 6, 54-8(1958) Jan.

Some problems relating to the dynamics of a quasi-neutral plasma formation situated in the field of a plane electromagnetic wave are considered. The method of successive approximations is employed. It is shown that within the limits of the assumptions underlying the analysis a plasma bunch tends to spread out. (auth)

8540

ON THE EFFECTIVE FIELD IN A PLASMA. B. B. Kadomtsev. Soviet Phys. JETP. 6, 117-22(1958) Jan.

The Bogoliubov equations for the "partial distribution functions" are used to compute the effective field acting on charged particles in a plasma. It is shown that the effective field differs from the mean field by a small quantity of

the order 1/N where N is the number of particles within a sphere whose radius is equal to the Debye radius. This result also holds in the presence of a magnetic field. (auth)

8541
INFLUENCE OF COULOMB CORRELATIONS ON THE ELECTRON PLASMA OSCILLATION SPECTRA. P. S. Zyryanov (Urals Polytechnical Inst.). Zhur. Eksptl'. i Teoret. Fiz. 34, 232-3(1958) Jan.

Electrons

8542
THE EFFECT OF RADIATION ON SYNCHROTRON OSCILLATIONS UNDER STRONG FOCUSING. A. N. Matveev (M. V. Lomonosov Moscow State Univ.). Soviet Phys. (Doklady) 1, 321-5(1956) May-June.

The synchronous oscillations of electrons under strong focusing are studied, and the equations of motion are derived. A comparison of the equations for the mean square phase deviations with weak and with strong focusing, all other conditions constant, shows that strong focusing somewhat reduces the amplitude of phase oscillations. In summation it can be said that, with respect to radiation-induced synchronous oscillations of electrons, strong focusing does not worsen, and in some instances improves, operating conditions compared with weak focusing. (J.S.R.)

8543
SECONDARY ELECTRON EMISSION FROM METALS INDUCED BY IONS AND NEUTRAL PARTICLES. V. G. Tel'kovskii. Soviet Phys. (Doklady) 1, 334-6(1956) May-June.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 1209.

8544
RADIO-FREQUENCY METHOD FOR MEASURING THE MASS OF RELATIVISTIC ELECTRONS. V. N. Lazukin (Moscow State Univ.). Soviet Phys. JETP. 6, 206-8(1958) Jan.

An experimental method is proposed for the measurement of the mass of relativistic electrons which is similar to that employed in radio-frequency mass-spectrometers and based on the application of the cyclotron resonance or the diamagnetic resonance of charged particles. For electron velocities higher than 0.7 a system based on the so-called inverse cyclotron is proposed. (J.S.R.)

8545
POLARIZATION IN DOUBLE SCATTERING OF ELECTRONS. Iu. V. Anishchenko and A. A. Rulchadze (P. N. Lebedev Inst. of Physics, Academy of Sciences, USSR). Soviet Phys. JETP. 6, 216-17(1958) Jan.

The Born approximations are derived for the constants in the equation for the differential cross section for double scattering of a longitudinally polarized beam of electrons. If the recoil of the nucleus for a two-component neutrino is neglected the beta electron polarization is $\eta = v/c$. Although experiments on double scattering of a polarized beam are difficult, neglect of the azimuthal symmetry in double scattering of decay electrons may lead to its own experimental error. A possible connection between double scattering and the so-called "anomalous" electron scattering which has been observed is suggested. (auth)

8546
INVESTIGATION OF THE RADIATION OF AN ELECTRON MOVING IN A MAGNETOACTIVE MEDIUM. V. Ya. Eidman (Gor'kii Inst. of Radio-Physics). Zhur. Eksptl'. i. Teoret. Fiz. 34, 131-8(1958) Jan. (In Russian)

The spectral and angular distribution of the energy emitted by an electron moving in a magnetoactive plasma is considered. The polarization of this radiation is also examined. (tr-auth)

Gases

8547 LA-2178
Los Alamos Scientific Lab., N. Mex.
THE EVALUATION OF THE KASSEL INTEGRAL VIA IBM 704. Eugene M. Willbanks. Jan. 1958. 68p. Contract W-7405-eng-36. $1.75(OTS).

One of the more useful theories concerning the kinetics of the thermal decomposition of gases is by Kassel and requires the evaluation of the Kassel integral. Because attempts to integrate this expression have failed, numerical integration seemed indicated. A high-speed digital binary computer, the IBM 704, was used to make multiple integrations feasible. A scaling factor was introduced into the integral to keep it within the limits of the computer (10^{-37} to 10^{38}). Simpson's rule was used. The complete calculation, including some parameter modification, was flow-diagrammed and then the problem was coded. An assembly program was used to convert the code into the binary language of the computer. Several thousand integrations were performed at different parameter values and the results compared with experimental data for azomethane and azoethane. The agreement was good in both cases. The average integration time for S = 12 and ΔE = 1000 calories was approximately 0.7 second. (auth)

8548 NYO-7980
New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center.
MOMENT DESCRIPTION OF GAS MIXTURES—I. Ignace I. Kolodner. Sept. 10, 1957. 44p. Contract AT(30-1)-1480. $7.80(ph OTS); $3.30(mf OTS).

A 13n moment description of n'ary gas mixtures can be constructed for the Boltzmann Equation using a procedure due to Grad. The densities, flow velocities, specific energies, stress tensors and heat flow vectors of individual components are considered to be fundamental quantities in this description. To achieve a determined set of macroscopic equations, the component velocity distribution function is approximated by means of a product of an exponential and a third degree polynomial which reduces to a Maxwellian distribution when stresses and heat flows are neglected, and otherwise yields the same fundamental 13 moments as the exact distribution function. The resulting moment equation includes various gas-mixture theories as special cases. On neglecting the spatial dependence (i.e., for local study) one obtains the theory of relaxation times. If stresses and heat flows are neglected and the temperatures are set equal, one obtains the Euler equations and their generalizations. Lastly, if stress, heat flows, temperature differences, and component velocity differences are assumed to be of first order, then it follows that (a) the temperature differences are, in case of uncharged fluids, of second order and thus can be neglected; (b) the stresses, heat flows and diffusional velocity can be expressed in terms of the thermodynamic variables, leading to the Chapman-Enskog theory of material constants and to the reduction of the system to Navier-Stokes equations complemented by a diffusion relation. For a plasma, the temperature differences are of first order, and thus one obtains a description involving individual temperatures of ions and electrons. Collisional terms in the moment equations were evaluated exactly in terms of certain integrals depending on the type of interaction. The latter were evaluated explicitly for the case of inverse power inter-

action laws (including elastic sphere model). In the case of charged components, the Coulomb interaction with a cut-off at Debye radius was assumed. For plasma, a marked simplification in the collisional terms is achieved by assuming that the ratio of electron mass to ion mass is small and by dropping terms multiplied by this ratio. (auth)

8549 UCRL-8165
California. Univ., Berkeley. Radiation Lab.
THE VOLUMETRIC AND THERMODYNAMIC PROPERTIES OF FLUIDS. V. TWO COMPONENT SOLUTIONS. Kenneth S. Pitzer and Glen O. Hultgren. Feb. 1958. 12p. Contract W-7405-eng-48. $0.50(OTS).

The acentric factor theory of volumetric behavior of pure fluids is applied to mixed gases. The pseudo-critical temperature and pressure and the acentric factor are evaluated for 12 binary systems each at several compositions. It is found that a linear equation in the mole fraction and the properties of the components is adequate for the acentric factor in all cases and for the pseudo-critical constants in some systems. In other systems small quadratic terms are required for the pseudo-critical temperature and pressure. The relationship of these quadratic terms to the intermolecular forces is considered. It is believed that useful predictions of fugacities as well as of volumetric data can be made on the basis of these results. (auth)

8550 IGRL-T/R-71
THE ANALYSIS OF GASES IN THE CHLORINATION PROCESS. A. S. Berengard and M. T. Glushkova. Translated by E. G. Peters from Zavodskaya Lab. 23, 537-9 (1957). 7p.

Constructional and operational details of an apparatus based on a standard type of gas analyzer, which measures the chlorine, hydrogen chloride, carbon dioxide, carbon monoxide, oxygen, and phosgene content of gases evolved in the process of chlorination, to an accuracy of 0.1% are given. This apparatus is in wide use in the Soviet nonferrous metals industry. (auth)

8551
HIGHER APPROXIMATIONS FOR THE TRANSPORT PROPERTIES OF BINARY GAS MIXTURES. III. ISOTOPIC THERMAL DIFFUSION. S. C. Saxena and E. A. Mason (Univ. of Maryland, College Park). J. Chem. Phys. 28, 623-5(1958) Apr.

Tables of the reduced isotopic thermal diffusion factor as a function of a reduced temperature are given for the exp-six potential with potential parameter α = 12, 13, 14, 15, and for the Lennard-Jones (n-6) potential with potential parameter n = 12, ∞. These tables are based on recently derived higher approximations and are intended to supersede previous tabulations, which are of lower accuracy. (auth)

8552
AN EXPERIMENT ON THE INTERACTION BETWEEN A PLANE SHOCK AND A MAGNETIC FIELD. K. Dolder and R. Hide (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature 181, 1116-18(1958) Apr. 19.

A preliminary report is presented from a study of the interaction of high-speed gas flow in a shock tube with a magnetic field, produced by a circular coil. A schematic sketch of the shock tube and photographs showing the light emitted by the hot gas at various pressures are included. (C.H.)

8553
DYNAMICAL INSTABILITY IN AN ANISOTROPIC IONIZED GAS OF LOW DENSITY. E. N. Parker (Univ. of Chicago). Phys. Rev. 109, 1874-6(1958) Mar. 15.

It is shown that when the thermal motions of a tenuous ionized gas are sufficiently anisotropic, the gas, and the initially uniform magnetic field which the gas is assumed to contain, become unstable. One mode of instability occurs when the gas pressure is greater parallel to the field than perpendicular, and another mode when the pressure is greater perpendicular than parallel. It is suggested that such instabilities may be of astrophysical interest, particularly with regard to the configuration of the solar dipole field as it is drawn out into interplanetary space by ionized gas from the sun. (auth)

8554
ABSOLUTE ENERGY TO PRODUCE AN ION PAIR IN VARIOUS GASES BY BETA PARTICLES FROM S^{35}. William P. Jesse (St. Procopius Coll., Lisle, Ill.). Phys. Rev. 109, 2002-4(1958) Mar. 15.

A repetition has been carried out of recent experiments in which the absolute average energy W_β required to form an ion pair in various gases was determined for the beta particles from S^{35}. The present experiments employ a new procedure, which eliminates almost entirely large correction terms necessary in the former ionization measurements. The two experiments are in good agreement and yield the modified values of 35.0, 24.6, and 33.9 ev/ion pair for W_β for N_2, C_2H_6, and air, respectively. (auth)

8555
MEASUREMENTS OF He^3-He^4 AND H_2-D_2 GAS DIFFUSION COEFFICIENTS. Philip J. Bendt (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 110, 85-9(1958) Apr. 1.

The gas diffusion coefficient for He^3-He^4 has been measured between 1.74 and 296°K, and for H_2-D_2 between 13.9 and 296°K. The diffusion bridge used to make the measurements is described. The experimental results are compared with viscosity measurements, and with classical and quantum-mechanical calculations based on the Lennard-Jones 12-6 and on the modified Buckingham exp-6 intermolecular potential fields. (auth)

8556
BREAKUP OF H_2^+, HD^+, AND D_2^+ IONS BY SINGLE COLLISIONS WITH HYDROGEN, DEUTERIUM, AND AIR MOLECULES. S. E. Kupriianov and V. K. Potapov (L. Ia. Karpov Physico-Chemical Inst.). Soviet Phys. JETP. 6, 244(1958) Jan.

When H_2^+, HD^+, and D_2^+ ions are scattered, they may break up in the following ways: $H_2^+ \rightarrow p + H$; $D_2^+ \rightarrow d + D$; $HD^+ \rightarrow p + D$; and $HD^+ \rightarrow d + H$. The relative probabilities for these processes when H_2^+, HD^+, and D_2^+ ions accelerated to 3000 ev are passed through hydrogen, deuterium, and air at pressures of about 5×10^{-4} mm Hg were determined. The results are tabulated. (J.S.R.)

Instruments

8557 AECU-3671
[Los Alamos Scientific Lab.], N. Mex.
TRANSIENT RESPONSE OF ACCELEROMETERS. William G. Soper. [195?]. 11p. Contract [W-7405-eng-36]. $3.30(ph OTS); $2.40(mf OTS).

An approximate method is presented for determining the response of an accelerometer to a polygonal acceleration pulse or to a curvilinear pulse which has been approximated by a series of straight line segments. The accelerometer is completely characterized by its natural frequency; the damping is not considered a variable. The treatment assumes that the damped oscillations occurring during each segment of the pulse sensibly vanish before the end of that segment. While this assumption does not

hold in general, of course, it is valid in the case of a particular pulse for all accelerometers whose natural frequencies exceed a certain values. The method is useful, therefore, in calculating the small discrepancies that must always exist between the applied acceleration and the accelerometer response. These discrepancies consist chiefly of attenuation of the acceleration peaks and a time-wise displacement of the entire pulse. With use of a little trial and error, the method also enables one to choose, for a given pulse, an accelerometer natural frequency which will insure any desired degree of accuracy in the response. (auth)

8558 HEPL-34

Stanford Univ., Calif. High Energy Physics Lab.

THEORY OF NONLINEAR FEEDBACK SYSTEMS HAVING A MULTIPLE NUMBER OF FIRST-ORDER OPERATING POINTS AND ITS APPLICATION TO MILLIMICROSECOND COUNTING TECHNIQUES [thesis]. Technical Report on LINEAR ELECTRON ACCELERATOR PROJECT. Jan A. Narud. Feb. 1955. 206p. Sponsored by ONR and AEC under Contract N6onr-25116. $1.00(OTS).

A secondary-emission counting circuit developed for high-speed counting is described and analyzed. The solution to the associated differential equation is derived in terms of the zeros of the steady-state equation which are shown to represent the stable and unstable operating points of the circuit. The transient response is discussed and an expression is obtained for the characteristic resolving time of the circuit. Then the effect of inserting two- and four-terminal coupling networks is considered, showing that the circuit may take on several modes of operation depending on the relative sizes of the components. Proper design values for the shunt-peaked case are given and the improvement obtained in transient response and resolving time by inserting such a network is discussed. The effects of applying trigger signals of various shapes and magnitudes are studied. The ordinary two-tube multivibrator is analyzed: (1) by breaking up the transition from one stable operating point to another into three intervals in each of which the circuit is assumed to behave linearly; and (2) by introducing certain simplifications into the differential equations of this circuit in which case they combine into a simple equation. It is shown that memory devices must contain nonlinear elements and that the transfer function of the system must satisfy certain basic requirements in order to be realizable. The possibility of representing this relation by analytical functions is discussed and the limitations imposed upon such functions by these requirements investigated. Also, it is shown that the zeros of the steady-state equation of the system must all be real and that these determine the location of the stable and unstable operating points. The behavior of the derivative of the nonlinear transfer function at these points is studied and a method outlined by which this function may be synthesized in terms of the zeros of the steady-state equation. Next, the transient behavior of the system is discussed: (1) where the nonlinear differential equation governing the system is of the first order, and (2) where it is of the second order. Solutions are obtained for these equations in terms of the zeros of the steady-state equations when all these zeros are of the first order. Several important properties are derived for such systems; e.g., it is shown that at any operating point the sum of the incremental loop-gain and the inverse of the corresponding residue is equal to unity, and that stable and unstable operating points alternate. The description of some of the fast electronic circuitry developed at the High-Energy Physics Laboratory is given. (auth)

8559 HW-55166

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A REMOTABLE FLOAT-TYPE LIQUID INTERFACE CONTROLLER. K. J. Hahn and H. M. Jones. Feb. 27, 1958. 9p. Contract W-31-109-Eng-52. $1.80(ph OTS; $1.80(mf OTS).

Float-type interface controllers have performed well and appear to have eliminated some of the problems associated with previously used interface control systems. Present plans are to install float-type instruments in the bottom disengagement section of extraction columns at the Purex Plant. (W.L.H.)

8560 IGR-R/CA-255

United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst Works, Capenhurst, Ches., England.

MEASUREMENT OF LIQUID–METAL LEVELS BY THE EFFECT OF EDDY CURRENTS ON AN INDUCTANCE. D. F. Davidson. Dec. 1957. 10p.

Remote-reading liquid-metal level indicators were developed for the proposed sodium-cooled test loop in the Dounreay materials testing reactor. The principle used is the effect of eddy currents on the inductance of a coil. The coil is made in the form of a probe which is inserted in a vertical stainless steel pocket in the tank. Tests were made in a test rig, using liquid metals, to prove the instruments and to provide calibration curves. An approximately linear scale is obtained for an instrument in a tank 6 in. deep, but the instrument for a 3-in. tank needs a calibration. A standardizing facility allows for changes in the electronic circuits and enables a simple correction to be applied for temperature changes. A search probe was constructed to assist in the tests. It may prove to be a valuable instrument in some applications, since it is self-calibrating and independent of temperature. (auth)

8561 SCTM-316-57(14)

Sandia Corp., Albuquerque, N. Mex.

PRINTED CIRCUITS. George Voida. Nov. 25, 1957. 35p. Contract AT(29-1)-789. $6.30(ph OTS); $3.00(mf OTS).

Processes used in the production of printed circuits are described. A description is presented of the different measures used for maintaining the quality of printed circuits. The advantages of printed circuits in electronic packaging are enumerated. The importance of printed circuits in the advancement of miniaturization is emphasized. Also included is a glossary of the terminology used in the field of printed circuitry. (auth)

8562 UCRL-5016

California. Univ., Livermore. Radiation Lab.

DESIGN AND CONSTRUCTION OF HIGH-FREQUENCY PHASE-SENSITIVE DETECTORS. Roger Dorr. Nov. 21, 1957. 6p. Contract W-7405-eng-48. $0.50(OTS).

A diode phase detector is described in which symmetry is maintained at high frequencies through the use of a simple bifilar input transformer. The signal input, reference voltage input, and dc output each have one terminal at ground potential, thus simplifying the connections between the phase detector and associated circuitry. (auth)

8563 AEC-tr-3193

MEASUREMENT OF INDIVIDUAL PULSES. Jaroslav Hájek. Translated from Slaboproudý obzor 18, 91-106 (1957) 16p.

In many cases, especially those where measurements are on a large scale, it is not necessary to know the time-dependence of a voltage pulse, but only its amplitude and sometimes its duration. This work examines a number of

questions that concern the development of an instrument which measures these two quantities independently for each individual nonrepetitive pulse, and some of their solutions are proposed. (auth)

8564

DATA PLOTTER. Ralph H. Müller and Frank D. Lonadier (Los Alamos Scientific Lab., N. Mex.). Anal. Chem. 30, 891-3(1958) May.

The incorporation of a multipoint printout recorder, a sliding translatory potentiometer, and other simple electrical equipment found in the laboratory provides a fast efficient way of plotting data received in tabular form. With simple modification of the electrical circuit, the apparatus will perform other useful functions such as squaring, taking logarithms, square rooting, or plotting hyperbolas. Use of the plotter increased speed from 1.5- to 2.5-fold over manually plotting the same points. (auth)

8565

INSTRUMENTAL METHODS OF DERIVATIVE POLAROGRAPHY. M. T. Kelley and D. J. Fisher (Oak Ridge National Lab., Tenn.). Anal. Chem. 30, 929-32(1958) May.

The authors have studied several instrumental techniques for recording derivative polarograms with dropping mercury electrodes, because the derivative technique permits resolution of polarographic waves with closely spaced half-wave potentials. Their efforts were devoted largely to improving the use of simple resistance-capacity differentiating networks by removing drop oscillations with minimum distortion. The parallel-T filter used to remove drop oscillations also permits effective application of the dual dropping electrode technique for recording derivative polarograms. The culmination of this work is a derivative polarograph using a combination of a diode filter with the parallel-T filter. Although the waves recorded with this instrument still show some slight dissymmetry, they permit very good resolution of waves with half-wave potentials as close as 60 mv. (auth)

8566

THE ACCURACY OF STRIP-THICKNESS MEASUREMENT BY BETA AND GAMMA ABSORPTION. E. B. Bell (Isotope Developments, Ltd., Aldermaston Wharf, near Reading, Eng.). J. Inst. Metals 86, 303-9(1958) Mar.

The fundamental and operational accuracy limitations of beta and gamma strip thickness gaging are considered, with particular reference to statistical and detector sensitivity variations, electronic drift, movement of absorber, and variations of these errors over the range of the instruments. (auth)

8567

A SENSITIVE ARRANGEMENT FOR THE OBSERVATION OF NUCLEAR MAGNETIC RESONANCE SIGNALS. N. M. Pomerantsev and V. I. Kvlividze. Pribory i Tek. Ekspt. No. 2, 56-9(1957).

The main experimental problem in nuclear magnetic resonance work is how to increase the signal-to-noise ratio. A description is given of an arrangement incorporating the full compensation of the signal of the amplifying channel input. The "resistive voltage" as frequency carrier is introduced after the amplification of a nuclear magnetic resonance signal. (J.S.R.)

8568

A HIGH SPEED OSCILLOSCOPE. Ya. M. Balats, P. I. Lebedev, and Yu. V. Obukhov. Pribory i Tek. Ekspt. No. 2, 63-7(1957).

A description and analysis of an oscilloscope for the photographic investigation of pulses with 3×10^{-9} sec rise time are given. (J.S.R.)

8569

SMALL CURRENTS INTEGRATOR. A. A. Kurashov and A. F. Linev. Pribory i Tek. Ekspt. No. 2, 70-4(1957).

A new "chopper" is described which gives better stability and simplicity of operation of d-c to a-c converters in d-c current amplification. This "chopper" has been used successfully in a small-current integrator for the measurement and integration of currents at a cyclotron target. The integrator is described in detail. (J.S.R.)

8570

A CASCADED VOLTAGE MULTIPLIER. M. L. Baskin. Pribory i Tek. Ekspt. No. 2, 78-83(1957).

A new theory for determining the parameters of cascaded voltage multipliers is proposed which would permit improving the effective power and the reduction of the internal resistance of the condenser-rectifier type of voltage multipliers. The theory is developed from the fact that for a given voltage and for given parameters the current at any point is a single-valued function of the load current which determines the voltage drop at any of the circuit components. It is found that in multipliers the capacitative voltage drop is of main importance and it is possible to compensate for it by producing a phase shift between voltage pulsation at different cascades. The theory was experimentally confirmed. (J.S.R.)

8571

INSTRUMENT FOR X-RAY PATTERN ANALYSIS. S. L. Nudel'man. Pribory i Tek Ekspt. No. 2, 83-8(1957).

The construction and use of an instrument for the analysis of x-ray patterns are described. With this instrument it is possible to determine the type, parameters, and indices of crystal lattices of cubical tetrahedral, hexagonal, and rhombic systems by the powder method. The type, system, and parameters of substances from which crystals cannot be grown can also be determined. (J.S.R.)

8572

AUTOMATIC INSTRUMENT FOR MEASURING MAGNETIC ANISOTROPY. I. M. Dmitrenko. Pribory i Tek. Ekspt. No. 2, 89-93(1957).

An instrument with automatic compensation action is described for the automatic measurement and recording of the diamagnetic susceptibility of a metal as a function of the reciprocal of the field. (J.S.R.)

8573

AN INSTRUMENT FOR MEASUREMENT OF PHOTOMULTIPLIER PARAMETERS. A. A. Sanin and N. N. Dmitriyeva. Pribory i Tek. Ekspt. No. 2, 103-5(1957).

The energy discrimination of scintillation spectrometers depends on the parameters of the photomultiplier, of the crystal, and on the construction of the instrument. A description is given of an instrument which can be used to determine the sensitivity of the photocathode at various points and the resolving characteristics of the photomultiplier when either the whole surface of the cathode or any point on it is used. (J.S.R.)

8574

DESIGN AND USE OF A UNIFORM HIGH INTENSITY COBALT-60 IRRADIATION CHAMBER. E. Nielsen (Univ. of California, Berkeley). Proc. Health Phys. Soc. 15-20 (1957).

A Co^{60} irradiation unit was designed with the specifications of a high uniform radiation field, immediate use for small samples, possible later use for large samples, and ability to handle multiple samples. The final machine also had the additional features of provision for cobalt replacement when decay indicated and provision to cover the expectation of increasing the Co^{60} content by a factor of 10. The operation of the machine is described. (J.S.R.)

8575
X-RAY STUDIES OF MATTER AT PRESSURES TO 30,000 ATMOSPHERES. L. F. Vereshchagin and I. V. Brandt (High Pressure Physics Lab., Academy of Sciences, USSR). Soviet Phys. (Doklady) 1, 312-13(1956) May-June.

A camera was developed for producing Debye x-ray patterns at pressures up to 30,000 atm. The camera and the experimental arrangement are sketched. Preliminary studies of bismuth showed that its discontinuous change of volume must be associated with a change in the crystal structure and not with intra-atomic transitions. (J.S.R.)

Isotopes

8576 BNL-487
Brookhaven National Lab., Upton, N. Y.
TABLE OF RADIOISOTOPES ARRANGED ACCORDING TO HALF-LIFE. Elaine Daniels, comp. Dec. 1957. 60p. $1.75(OTS).

The tabulated data on radioisotopes are taken directly from the General Electric Chart of the Nuclides, Fifth Edition. The half lives, decay particles and energies, gamma energies, and total energy or mass are included in the table. (J.E.D.)

8577 ORNL-1228(Del.)
Oak Ridge National Lab., Tenn.
STABLE ISOTOPE RESEARCH AND PRODUCTION DIVISION QUARTERLY PROGRESS REPORT [FOR] OCTOBER 1, 1951 TO DECEMBER 31, 1951. J. R. Walton, ed. Jan. 2, 1952. Decl. with deletions Feb. 21, 1957. 32p. Contract W-7405-eng-26. $6.30(ph OTS); $3.00(mf OTS).

Progress of research on separation and collection of stable isotopes of Li, Fe, and Ca is reported. Nuclear resonances of V^{50} and Fe^{99} were investigated. A brief survey is presented on isotope analysis methods and mass spectrometric studies. (W.L.H.)

8578
ON THE MOTION OF IONS IN A MIXTURE OF ISOTOPES. Yu. M. Kagan and V. I. Perel (Leningrad Inst. of Precision Mechanics and Optics). Zhur. Eksptl'. i Teoret. Fiz. 34, 126-8(1958) Jan. (In Russian)

Expressions for the drift velocity of ions of isotopes in a mixture of isotopes are derived. The primary interaction process between the ions and atoms is assumed to be of pure charge exchange nature. (tr-auth)

Isotope Separation

8579 KAPL-M-FFM-2
Knolls Atomic Power Lab., Schenectady, N. Y.
ENRICHMENT OF DYSPROSIUM 164. F. F. Mikus. Apr. 8, 1958. 8p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

Methods of enrichment of Dy^{164} from its naturally occurring abundance of 28% to about 60%, for use as a burnable poison, were investigated. Electromigration in an aqueous solution, electromigration in fused salts, and thermal diffusion separations are described. Further development of these methods is indicated as well as ion exchange separation. (J.R.D.)

8580
PREPARATION OF CARRIER-FREE VANADIUM, SCANDIUM, AND ARSENIC ACTIVITIES FROM CYCLOTRON TARGETS BY ION EXCHANGE. Ulrich Schindewolf and J. W. Irvine, Jr. (Massachusetts Inst. of Tech., Cambridge). Anal. Chem. 30, 906-8(1958) May.

A separation of carrier-free vanadium and scandium activities from deuteron-bombarded titanium targets is effected by differential absorption from hydrofluoric acid solutions on an anion exchange column. In dilute hydrofluoric acid solution, scandium and titanium are strongly absorbed and vanadium(IV) is eluted. With 15M hydrofluoric acid, scandium is eluted before titanium. Similarly, carrier-free arsenic activities are separated from deuteron-bombarded germanium targets. From diluted hydrofluoric acid both germanium and gallium are absorbed by an anion exchange column, while arsenic(III) passes through. (auth)

8581
RECONSTRUCTION OF THE ISOTOPE SEPARATOR AT THE NOBEL INSTITUTE OF PHYSICS. Torsten Alväger and Jan Uhler. Arkiv Fysik 13, 145-63(1958).

At the Nobel Institute an electromagnetic isotope separator has been working since 1948. Applications of this have been separations of radioactive material used in nuclear spectroscopy and preparation of targets of stable isotopes for nuclear reaction studies. However, such work in the lead region emphasized the importance of better resolution, which was found to be attainable by using the analyzing magnet as a symmetrical sector field. To fulfil the new requirements, an extensive reconstruction of the isotope separator has been made, including a new vacuum system and lens system. Further, the instrument has been made two directional focusing by an electrostatic cylinder lens, with which it is possible to diminish the line height by a factor of 5, or to 10 mm, without any appreciable defocusing. To analyze the focusing properties a partly new method has been developed which makes it possible to make continuous observation of the mass lines during the separation. The resolving power obtained is about 1400; the over-all efficiency corresponding to this value is a few percent. (auth)

Mass Spectrography

8582
INTEGRAL MASS-SPECTROGRAPHIC METHOD OF DETERMINING THE CONCENTRATION OF ELEMENTS. V. K. Gorshkov. Pribory i Tek. Ekspt. No. 2, 53-6(1957).

A method of determining the element concentrations in solids by using a two-wire ion source with surface ionization is described. The ionization temperature is approximately 2600°K. The element concentration is determined by comparing the integrated mass spectrogram of the unknown with the integrated spectrogram of a master sample. The relative ionization coefficients of barium, lanthanum, cerium, neodymium, praseodymium, samarium, and europium were determined. Concentrations of monoisotopic elements such as sodium, aluminum, promethium, praseodymium, and terbium can be easily determined. (J.S.R.)

Mathematics

8583 AECU-3584
Illinois. Univ., Urbana. Digital Computer Lab.
TECHNICAL PROGRESS REPORT. PART I. STUDY PROGRAM ON HIGH-SPEED COMPUTER. PART II. SWITCHING CIRCUIT THEORY. PART III. MATHEMATICAL METHODS. PART IV. ILLIAC USE AND OPERATION—GENERAL LABORATORY INFORMATION. Sept. 1957. 24p. Contracts AT(11-1)-415; N6ori-07130; and Nonr-1834(15). $3.30(ph OTS); $2.40(mf OTS).

8584 IFA-FT-21
Academia R. P. R. Institutul de Fizică Atomică, Bucharest.
LES ENSEMBLES STATISTIQUES EN RELATIVITÉ

RESTREINTE. (Colectivele Statistice în Relativitatea Restrînsă.) (The Statistical Systems in Special Relativity.) S. Ţiţeica. 1956. 4p.

In classical mechanics a system of point particles is characterized by a distribution function F. An invariant definition is given and an invariant law of evolution is formulated for the function F. (J.S.R.)

8585 IFA-FT-24
Academia R. P. R. Institutul de Fizică Atomică, Bucharest.
FORMULATION COVARIANTE DES LOIS DE LA MECANIQE STATISTIQUE. (Formularea Covariantă a Legilor Mecanicii Statistice.) (Covariant Formulation of the Laws of Statistical Mechanics.) S. Ţiţeica. 1956. 6p.

8586 KAPL-M-CJH-3
Knolls Atomic Power Lab., Schenectady, N. Y.
LOST, A CROSS-SECTION AVERAGING PROGRAM FOR THE IBM 650. Celesta J. Hibbert. [1955?]. 39p. Contract [W-31-109-Eng-52]. $6.30(ph OTS); $3.00(mf OTS).

LOST, an IBM-650 program for computing cross section integrals over specified lethargy groups, is described. (M.H.R.)

8587 NDA-10-161
Nuclear Development Associates, Inc., White Plains, N. Y.
A PROCEDURE FOR THE NUMERICAL INTEGRATION OF THE BOLTZMANN TRANSPORT EQUATION.
J. Certaine and P. S. Mittelman. July 14, 1955. 46p. For Pratt and Whitney Aircraft Div. $7.80(ph OTS); $3.30 (mf OTS).

The direct numerical integration of the Boltzmann transport equation, using a high speed digital computer, is proposed to determine the high energy neutron and gamma ray angular fluxes at points interior to and at the surface of a reactor-shield assembly. The techniques developed in the course of the NDA neutron-penetration program are adapted to reduce the Boltzmann transport equation to a form where the Los Alamos "S_n" method may be used to obtain a solution. A detailed formulation of the calculational procedure is given for spherical multilayer assemblies. (auth)

8588 ORNL-1360(Del.)
Oak Ridge National Lab., Tenn.
MATHEMATICS PANEL QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1952. C. L. Perry, ed. Oct. 27, 1952. Decl. with deletions Feb. 22, 1957. 25p. Contract W-7405-eng-26. $4.80(ph OTS); $2.70(mf OTS).

The background and status of the following projects of the Mathematics Panel are reported: test problems for the ORAC arithmetic unit; errors in matrix operations; basic studies in the Monte Carlo method; A Sturm-Liouville problem; approximate steady-state solution of the equation of continuity; estimation of volume of lymph space; x-radiation effects on respiration rates in grasshopper embryos; temperature effects in irradiation experiments with yeast; LD_{50} estimation for burros and swine exposed to γ radiation; thermal-neutron penetration in tissues; kinetics of $HBr-HBrO_3$ reaction; isotope effect in reaction rate constants; experimental determination of diffusivity coefficients; Dirac wave equations; fitting a calibration curve; beta decay (field factors); neutron decay theory; calculation of internal conversion coefficients with screening; estimation of alignment ratios; optimum allocation of counting time; calculation of coincidence probabilities for a double-crystal detector; reactor inequalities; heat flow in long rectangular tubes; solving an equation by numerical methods; numerical integration; evaluation of a function; depigmentation of a biological dosimeter. (L.M.T.)

8589 ORNL-2170
Oak Ridge National Lab., Tenn.
TABLES OF SOLID ANGLES AND ACTIVATIONS. I. SOLID ANGLE SUBTENDED BY A CIRCULAR DISC. II. SOLID ANGLE SUBTENDED BY A CYLINDER. III. ACTIVATION OF A CYLINDER BY A POINT SOURCE.
A. V. H. Masket, R. L. Macklin, and H. W. Schmitt. Nov. 1956. 77p. Contract W-7405-eng-26. $0.45(OTS).

The solid angles subtended by discs and cylinders have been calculated for a large range of disc and cylinder dimensions and spacings and are presented in tabular form. The interaction of radiation from a point source on right cylindrical bodies is calculated for a large range of cylinder dimensions and spacing. (W.D.M.)

8590 Y-F10-61(Del.)
Oak Ridge National Lab., Y-12 Area, Tenn.
IBM PROCEDURE FOR B_4C LAYER BETWEEN CORE AND REFLECTOR BY THE COVEYOU METHOD. C. B. Mills. June 28, 1951. Decl. with deletions Feb. 21, 1957. 7p. Contract W-7405-eng-26. $1.80(ph OTS); $1.80(mf OTS).

A set of equations relating neutron fluxes in a reactor with an absorbing layer between core and reflector has been developed by R. Coveyou (Y-F10-52). This method involves determination of flux distribution in one region due to the current from another region of a reactor and requires addition of slowing down and transport contributions for an evaluation of the flux in any one lethargy group. Two parallel calculations must be made for flux distribution in the reactor, one with no source term in the core and another with no source term in the reflector. Transport calculations then permit the addition of a corrective term to core and reflector flux to determine the distribution in both. Source terms are then obtained for the next higher lethargy group in the usual way. (auth)

8591 APEX-361
ON THE METHOD OF SPHERICAL FUNCTIONS IN ATMOSPHERIC OPTICS. S. Ya. Kogan. Translated by James F. Heyda from Doklady Akad. Nauk S.S.S.R. 108, 1053-5 (1956). 8p. (XDC-58-2-62).

A theoretical procedure is presented for resolving an apparent ambiguity in the manner of satisfying boundary conditions for the one-dimensional transport equation. (auth)

8592
AN ELECTRONIC DIFFERENTIAL ANALYSER. A. K. Choudhury and B. R. Nag (Calcutta Univ.). Indian J. Phys. 32, 91-108(1958) Feb.

The electronic differential analyzer having sixteen operational amplifiers is described. The analyzer is specially designed for solving equations arising in connection with research works on circuit theory, servo-mechanisms, and electron trajectories. The analyzer works both repetitively and non-repetitively. Different sources of error of the computer elements are also discussed. Accuracy of the solutions obtainable by the machine is illustrated by some examples. (auth)

Measuring Instruments and Techniques

Refer also to abstract 8798.

8593 AECU-3680
General Mills, Inc., Minneapolis.
UPPER ATMOSPHERE MONITORING PROGRAM— PHASES I AND II. Quarterly Report Covering Period January 1, 1957 thru April 1, 1957. (Report 1695). Sidney Stern, William Zeller, Alfred Scheckman, Robley Stuart, and Sam Jones. Apr. 30, 1957. 55p. Project 89125. Con-

tract AT(11-1)-401. $9.30(ph OTS); $3.60(mf OTS).

Radioactive particulates were collected at high altitudes by means of high volume air samplers suspended from balloons. The recirculation problems inherent in sampling dust from stable platforms suspended are discussed in detail and a solution to this problem is offered. The filtration efficiency of IPC paper is described and evidence offered for disagreement between simultaneous aircraft and balloon samples obtained at the same altitude. The development of an accurate air flow meter that is capable of functioning at low densities and low temperature is covered. The development of a balloon and allied instrumentation for particulate sampling at three altitudes on a single flight is described. (auth)

8594 AECU-3681

General Mills, Inc., Minneapolis.

UPPER ATMOSPHERE MONITORING PROGRAM—PHASES I AND II. Progress Report No. 2 Covering Period April 1, 1957 thru October 1, 1957. (Report No. 1798). Sidney Stern, William Zeller, Alfred Scheckman, Robley Stuart, and Sam Jones. Nov. 11, 1957. 57p. Project 89125. Contract AT(11-1)-401. $9.30(ph OTS); $3.60(mf OTS).

Further work on (a) filter efficiencies and pressure drops for varying flow rates, (b) redesign of the present sampling device, (c) theoretical study on collection by impingement or impaction, and (d) the method used and instrumentation developed for calibration of the previously developed high altitude air flow meter is covered. (For preceding period see AECU-3680.) (auth)

8595 AFOSR-TR-58-139

New York Univ., New York. Coll. of Engineering.

RADIUS EFFECT IN BORON TRIFLUORIDE COUNTERS. Raymond M. Chang. Dec. 1957. 47p. Contract AF18 (600)-1460. (AD-152166).

The radius effect in boron trifluoride counters is defined as the progressive diminution of the flatness of the plateau as the radius of the counter is increased. A set of systematic tests of this effect were carried out. By using ordinary BF_3 it is shown at what radius the effect sets in. By careful purification, it is shown that the effect can be reduced. However, it was not reduced to zero. The possibility that the effect is due to field distortion inside the counter is critically examined, tested, and shown not to be the principal factor. Finally, in the discussion, the directions for future research are indicated. (auth)

8596 BLG-17

Brussels. Centre d'Etude de l'Énergie Nucléaire.

SUR UNE TECHNIQUE PHOTOGRAPHIQUE DE COMPTAGE D'EVENEMENTS DANS LES EMULSIONS NUCLEAIRES: S'APPLIQUANT A LA DETERMINATION DE LA DENSITE EN NEUTRONS THERMIQUES. (On a New Photographic Technique for Counting the Events in Nuclear Emulsions: Application to the Determination of Thermal Neutron Density.) C. Beets and J. Fournaux. Feb. 3, 1958. 15p.

A new photographic technique is proposed for counting the $B^{10}(n,\alpha)Li^7$, $Li^6(n,\alpha)H^3$, and $N^{14}(n,p)C^{14}$ reactions that are used in the nuclear-emulsion method of measuring thermal-neutron densities. This new technique greatly lessens the fatigue caused by such measurements; moreover, it permits the determination of how the density of the loading elements varies along the emulsion's depth and between emulsions of a given batch; the determination of counting cells with constant volume, thereby eliminating fluctuations caused by the variation of the cell volumes, correcting factors for "protruding" tracks, and correcting errors due to random alignments of emulsion grains in the vicinity of emulsion-air and emulsion-glass interfaces; and greatly increases the permissible number of tracks per cell, thereby enlarging the field where the nuclear emulsion method is applicable. (tr-auth)

8597 HASL-12

New York Operations Office. Health and Safety Lab., AEC.

PULSE AMPLIFIERS USING TRANSISTOR CIRCUITS. R. T. Graveson and H. Sadowski. Jan. 23, 1958. 19p. $0.75(OTS).

Transistor circuits simplify the design of pulse amplifiers because of their essentially linear gain characteristics. The low heat dissipation of such circuits permits small packages. The variations in transistor gain and leakage can be minimized by converting thehigh single stage gain to stability through the use of emitter feedback. Linearity and response to fast rise pulses is shown for specific scintillation amplifier circuits. (auth)

8598 IFA-PN-13

Academia R. P. R. Institutul de Fizică Atomică, Bucharest.

L'ACTION DES VAPEURS Hg SUR LES ÉMULSIONS PHOTOGRAFIQUES NUCLÉAIRES. (Actiunea Vaporilor de Hg Asupra Emulsiilor Nucleare.) (The Effect of Hg Vapor on Photographic Nuclear Emulsions.) M. Nicolae. 1956. 10p.

Preliminary results of the effect of mercury vapors on nuclear emulsions showed a decrease in the number of alpha tracks formed and preserved when the plates were impregnated with thorium nitrate and exposed to mercury vapor for seven days. To explain the results, further studies were made. Two nuclear plates were simultaneously impregnated with thorium. One of the plates was then exposed to mercury vapor for 10 days in a vacuum chamber under a pressure of 10^{-2} mm/Hg. The other was kept at the same pressure using an oil vacuum gage. The plates were developed simultaneously. There was a 6% decrease in the number of alpha tracks in the plate exposed to mercury vapor. The effect on the sensitivity of the plates was studied by exposing one plate to mercury vapor for 7 days, impregnating both the sample and control simultaneously with thorium and developing immediately. A 16% decrease was noticed in the number of alpha tracks. The probable mechanisms of the decrease in sensitivity and of regression are discussed. (J.S.R.)

8599 MC-217

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

COUNTING RATES IN BF_3 ARGON CHAMBERS. N. Miller. Jan. 17, 1946. Decl. May 31, 1954. 10p. (AECL-112).

A set of experiments were carried out in which an ionization chamber maintained in a constant thermal neutron flux was filled successively with mixtures of BF_3 and argon of various concentrations and at various total pressures. The following points were proved: (1) That the counting rate in the chamber was proportional within 2% to the partial pressure of boron trifluoride irrespective of the total pressure of the mixture. (2) That mixing of the two gases by diffusion was very slow; 7 days standing being required within the apparatus used before the counting-rate became constant after mixing. (3) That no significant separation of the two gases occurred when a mixture was suddenly admitted to the evacuated chamber through a narrow capillary. (auth)

8600 NAA-SR-Memo-978

North American Aviation, Inc., [Downey, Calif.].

HIGH VOLTAGE REGULATION IN BERKELEY SCALERS. J. K. Taylor. Apr. 30, 1954. 21p. $4.80(ph OTS); $2.70(mf OTS).

An experiment was made to determine the efficiency of the voltage regulator tubes, 991 and 5651, in the Berkeley scalers, models 100 and 2000. The results show that the

replacement of the 991 by the 5651 does not increase the efficiency of the regulated voltage supply, but replacement by a JADK 991 did increase the efficiency. (W.D.M.)

8601 NP-6665

Ansco Div., General Aniline and Film Corp., Binghamton, N. Y.

GAMMA-RAY INSENSITIVE EMULSIONS. Quarterly Report No. 7 [for] October 1, 1957–December 31, 1957. D. A. Nepela and H. F. Nitka. 19p. Contract DA-36-039-sc-70172.

Previous work on the possibility of re-covering gamma-irradiated film for a subsequent light exposure was continued in order to learn more about the relative contribution of surface sensitivity centers and latent image centers after a bleach treatment. The considerable speed loss due to this treatment for a subsequent light exposure can be related to the presence of a relatively strong internal image caused by the gamma-ray exposure. Emulsions having a high surface/internal sensitivity ratio are advantageous for recovery treatment although even with such emulsions a speed loss of several stops is encountered. Further experiments were made on the tolerable dosage for obtaining acceptable image records if the fogging radiation varies in energy. Due to the increased sensitivity of photographic emulsion to lower energy radiation, the tolerable dosage decreases for softer gamma- and x-rays with which the film is exposed. No change in tolerable dosage is expected for radiation energies higher than that of a Co^{60} source. Development retarders incorporated into the photographic emulsion do not provide a tool for increasing the light to gamma-radiation speed ratio. The reversal and dye intensification technique described previously was successfully extended to five different commercial negative materials. (auth)

8602 NYO-8576

Rochester, N. Y. Univ.

FEASIBILITY OF PROTON POLARIZATION MEASUREMENT WITH A CARBON POLARIMETER. Robert E. Warner and W. Parker Alford. Jan. 2, 1958. 14p. Contract AT(30-1)-875. $3.30(ph OTS); $2.40(mf OTS).

Calculations and measurements show that it is possible to determine the polarization of protons of energy 4.9 to 5.4 Mev by scattering from a carbon target. The polarization efficiencies of carbon and helium are quite comparable in this energy range. After scattering from carbon protons have a larger average energy and a smaller energy spread than after scattering from helium. Because of these facts, and its larger differential cross section for elastic proton scattering, carbon appears superior to helium as a polarization analyzer in the energy range in which it can be used. (auth)

8603 RIB-15

DuMont (Allen B.) Labs., Inc. Tube Research Labs., Passaic, N. J.

DEVELOPMENT OF DUMONT PHOTOMULTIPLIER TUBES. Report No. 20 [for] December 1, 1955 to February 28, 1956. B. R. Linden, Philip A. Snell, and F. W. Schenkel. 15p. Contract AT(30-1)-1336. $0.20(OTS).

The development of the K1328 (16" diameter) phototube has reached a point where it is now being put into the pilot production stage. Work on the K1384 ($12\frac{1}{2}$" diameter tube) has progressed satisfactorily. These tubes utilize the split cone technique, cutting their weight in half and improving the average characteristics of the tubes. The gain of the multiplier phototubes as a function of the counting rate is being investigated. A new experimental tube for measuring transit time spread has been constructed using a revised design in the secondary gun structure, permitting the beam to be focused into a spot size of $\frac{1}{4}$". Another group of $\frac{3}{4}$" diameter, Cs–Sb dynode tubes (K1382) were tested, and amounts of cesium and antimony were varied in an attempt to improve the gain of the tubes. A tube employing the new linear structure is being investigated. (For preceding period see RIB-14.) (W.D.M.)

8604 AEC-tr-3195

A STANDARD OF DENSITY FOR THERMAL NEUTRONS WHICH CAN BE REPRODUCED EASILY. René Cohen and Roland Barloutaud. Translated from Compt. rend. 238, 2413-14(1954). 2p.

It is proposed that a density standard for thermal neutrons of $(5.70 \pm 0.19) \times 10^{-3}$ n/cm^3 be adopted. This is the density established in the volume occupied by a copper desk of 15.00 mm diameter and of 500 mg/cm^2 surface density and which induces a maximum activity of Cu^{64} giving a counting rate of one pulse per second in the interior of a 4π counter. (M.H.R.)

8605

A PARTICULARLY FINE-GRAINED NUCLEAR EMULSION. N. A. Perfilov, N. R. Novikova, and E. I. Prokofeva. Atomnaya Energiya 4, 45-51(1958) Jan. (In Russian)

A method has been devised for the preparation of extremely fine emulsions with uniform microcrystals. A suggestion is offered for the application of potentiometric control of the emulsification process which secures a good photoemulsion reproduction. The developed emulsion is suitable for recording charged particles with high sensitivity. (tr-auth)

8606

GAMMA HODOSCOPE. B. S. Dzelepov. Izvest. Akad. Nauk S.S.S.R. Ser. Fiz. 21, No. 12, 1580-2(1957) Dec. (In Russian)

The working principle of a device for measuring weak intensities of hard γ spectra (γ-ray intensity less than 10^{-5}) is described and evaluated. (R.V.J.)

8607

CAVITY IONIZATION AS A FUNCTION OF WALL MATERIAL. Frank H. Attix, LeRoy DeLa Vergne, and Victor H. Ritz. J. Research Natl. Bur. Standards 60, 235-43 (1958) Mar.

A study has been made of the ionization within a flat cavity chamber under irradiation by x- and gamma rays in the energy region 38 to 1,250 kilovolts effective (kev). Chamber walls were made of carbon, aluminum, copper, tin, and lead, and the wall separation was varied from 0.5 to 10 millimeters. Results are compared with cavity theory. (auth)

8608

AN AUTOMATIC QUARTZ-FIBRE ELECTROMETER. M. C. B. Russell and J. Leng (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Sci. Instr. 35, 134-8(1958) Apr.

A quartz-fiber electrometer with auxiliary equipment is described, whereby an average rate of change of potential may be determined with probable errors of about ± 0.2 mv in the change of potential, and ± 0.02 s in the measurement of time. An instrument for automatic recording of β activity within the range 0.04 to 30 μc is described in detail with experimental results. (auth)

8609

A DESIGN OF A LABORATORY RADIATION DETECTOR FOR AUTOMATIC AND SEMI-AUTOMATIC MEASUREMENTS OF RADIOACTIVE PREPARATIONS. L. Novak and B. Hosek. Jaderna Energie 4, No. 2, 62-3(1958). (In Czech.)

8610

TEMPERATURE DEPENDENCE OF GAMMA-RAY SCINTILLATIONS IN THALLIUM-ACTIVATED CESIUM

IODIDE CRYSTALS. S. N. Komnik, V. I. Startsev, and Yu. A. Tsirlin. Optika i Spektroscopiya 4, 411-12(1958) Mar. (In Russian)

The studies were carried out at 30 to 150° temperature. It was found that near room temperature the scintillation intensity diminishes ~0.7%/degree. (R.V.J.)

8611

A FREE-MOVING ISODOSE-TRACING MACHINE. B. C. Green and J. W. T. Spinks (Univ. of Saskatchewan, Saskatoon, Can.). Nucleonics 16, No. 4, 92-4(1958) Apr.

A free-moving machine which can trace out isodose curves in an area contaminated by nuclear explosions is described. The machine consists of a small motor-propelled G-M tube. The tube is mounted vertically on a small two-wheeled cart, with each wheel being driven independently by a reversible electric motor. A tracing pencil is located on the right bisector of the axle. The G-M tube output is fed to a ratemeter type of circuit, and compared by a differential amplifier with a fixed but adjustable voltage from a potentiometer. Relays in the amplifiers control the direction of rotation of the electric motors. A diagram of the isodose tracer and sample operational curves are given. (J.S.R.)

8612

APPARATUS FOR THE SEMI-AUTOMATIC REGISTRATION AND ANALYSIS OF GAP-LENGTHS IN TRACKS IN NUCLEAR EMULSIONS. A. Starzýnski (Inst. of Nuclear Research, Warsaw). Nukleonika 3, 69-82(1958). (In Polish)

A description is given of an apparatus designed by the Warsaw Institute of Nuclear Research for the automatic measurement of ionization induced by charged particles in nuclear research emulsions. The apparatus segregates the gaps according to their length and distributes them into 8 channels. Finally it computes the total gap length, excluding the extremely short gaps. (tr-auth)

8613

PROPORTIONAL FLOW COUNTER 2π TYPE AET-60. Edmund Strychalski (Inst. of Nuclear Research, Warsaw). Nukleonika 3, 111-12(1958). (In Polish)

8614

G-M FLOW COUNTER ABAT 30/0. Edmund Strychalski (Inst. of Nuclear Research, Warsaw). Nukleonika 3, 113-14(1958). (In Polish)

8615

BORON TRIFLUORIDE NEUTRON COUNTERS TYPE NUM-12. Adam Kazimierski (Inst. of Nuclear Research, Warsaw). Nukleonika 3, 114-15(1958). (In Polish)

8616

CYLINDRICAL PROPORTIONAL COUNTER TYPE AEM-60. Edmund Strychalski (Inst. of Nuclear Research, Warsaw). Nukleonika 3, 116-17(1958). (In Polish)

8617

GAS DISCHARGE COUNTERS FOR IONIZING PARTICLES. A. B. Dmitriyev. Pribory i Tek. Ekspt. No. 2, 3-10(1957).

A detailed survey of the characteristics of the gas discharge counters designed and produced in the Soviet Union is given. (J.S.R.)

8618

INVESTIGATION OF THE ENERGY SPECTRUM OF PROTONS OF THE INTERNAL BEAM OF A PHASOTRON. Yu. D. Prokoshkin and G. N. Tentyukova. Pribory i Tek. Ekspt. No. 2, 18-22(1957).

A method for the experimental determination of the energy spectrum of the internal beam of a phasotron is discussed. The experimental arrangement consists of a system of equally spaced vertical metal wires in the plane perpendicular to the direction of the beam. The wires, which are made very thin so as not to induce beam distortion, are activated by the beam, and the degree of activation measured by proportional counters. Proton energies of 400, 550, and 650 Mev at the target were used. The wire activity was found to be constant for the three values of proton energy within the experimental error of 3%. The energy and amplitude distributions of the free radial vibrations of the particles were evaluated. The mean proton energy spread was 12 ± 3 Mev. (J.S.R.)

8619

AN APPLICATION OF THE WILSON CLOUD CHAMBER TO PHOTONUCLEAR STUDIES. A. N. Gorbunov, V. M. Spiridonov, and P. A. Cherenkov. Pribory i Tek. Ekspt. No. 2, 29-32(1957).

The procedures adopted at the Institute of Physics of the Academy of Sciences of the USSR for the observation with a Wilson cloud chamber of photonuclear processes induced by high gamma radiation from a synchrotron are described. (J.S.R.)

8620

A PHOTOMETRIC DETERMINATION OF IONIZATION IN THE WILSON CLOUD CHAMBER. V. M. Fedorov. Pribory i Tek. Ekspt. No. 2, 32-7(1957).

Methods of determining particle ionization in a Wilson cloud chamber from photographic measurements are reviewed. (J.S.R.)

8621

GRAPHICAL METHOD OF DETERMINING THE ENERGY AND ANGLES OF DISPERSION OF TWO MOVING RELATIVISTIC PARTICLES. L. M. Barkov and B. A. Nikol'skiy. Pribory i Tek Ekspt. No. 2, 40-3(1957).

The interaction of high-energy nucleons and π mesons with nuclei may be regarded as a result of their interaction with separate nucleons in the nucleus. A graphical method is given for a rapid determination of the energy and of the scattering angles of two moving particles for the case when the characteristics of their interaction are known in the center-of-mass system. (J.S.R.)

8622

INVESTIGATION OF THE ANGULAR DISTRIBUTION OF PARTICLES FROM THEIR TRACES IN A PHOTO-EMULSION. V. I. Ostroumov and R. A. Filov. Pribory i Tek. Ekspt. No. 2, 44-5(1957).

A method is derived for evaluating the solid angle distribution from the plane angular distribution in a nuclear emulsion. (J.S.R.)

8623

METEOROLOGICAL COEFFICIENTS FOR 4π AND 2π COUNTER TELESCOPES. Ya. L. Blokh and L. I. Dorman. Pribory i Tek. Ekspt. No. 2, 46-8(1957).

The theoretical values of the barometric pressure coefficients and of the temperature coefficients which can be used with cubical telescopes at sea level and with semi-cubical telescopes underground at depths of 25 and 55 mwe are given. (J.S.R.)

8624

A MICROSCOPE STAGE FOR PARTICLE SCATTERING MEASUREMENTS IN NUCLEAR PHOTOEMULSIONS. A. O. Vaysenberg, V. A. Smirnitskiy, and N. V. Rabin. Pribory i Tek. Ekspt. No. 2, 112-14(1957).

A microscope bench using two accurately prepared glass plates as guides has been constructed and is described in detail. (J.S.R.)

8625

INVESTIGATION INTO POSSIBILITY OF CONSTRUCTING AN INSTRUMENT FOR THE AUTOMATIC SCANNING OF THICK FILMS OF PHOTOGRAPHIC EMULSIONS. V. V.

Glagolev and R. M. Lebedev. Pribory i Tek. Ekspt. No. 2, 114-16(1957).

The possibility of constructing an instrument which would automatically inspect particle tracks in nuclear emulsions is discussed. An instrument using two photomultipliers added to a type MB-8 microscope is shown. The trace is projected on the cathode of one of the photomultipliers and the background on the other. A microammeter determines the track-background difference. It was found that for work with relativistic particles it is necessary either to increase the density and size of the grains or to introduce summation over several inspection fields. But experiments have shown that it is possible to obtain a stable signal source for automatic inspection of tracks. (J.S.R.)

8626

A FAST NEUTRON INSENSITIVE GAMMA DOSIMETER. J. A. Auxier and G. S. Hurst (Oak Ridge National Lab., Tenn.). Proc. Health Phys. Soc., 3-7(1957).

A technique has been developed which promises to decrease the effect of fast neutrons during gamma detection and measurement. It involves the use of a miniature cavity with walls and gas of materials having atomic numbers of 6 to 16 inclusively. The device is used as a "semi" proportional counter in which gas amplification extends out into the cavity and perhaps to the walls. (J.S.R.)

8627

A SIMPLIFIED FAST NEUTRON FILM DOSIMETER. S. W. Ross and E. Tochilin (U. S. Naval Radiological Defense Lab., San Francisco). Proc. Health Phys. Soc. 98-100(1957).

A fast neutron film dosimeter with which the neutron dose can be determined directly from density measurements is described. It consists of polyethylene front and back. Tin and silver strips back the plastic and are in direct contact with the film. The badge can also be used to monitor gamma radiation. (J.S.R.)

8628

THE VARIATION OF NEUTRON DOSE WITH NEUTRON ENERGY AND GEOMETRY. W. S. Snyder (Oak Ridge National Lab., Tenn.). Proc. Health Phys. Soc. 108-13 (1957).

An attempt is made to give rough limits on the degree of variability to be expected in the determination of the dependence of neutron dose on neutron energy or the geometry of the source and irradiated phantom. The discussion is chiefly concerned with the site of maximum dose. Methods of estimating the site of maximum dose are given. (J.S.R.)

8629

DUAL ION CHAMBER NEUTRON DETECTOR. J. C. Hunter (Univ. of California, Livermore). Proc. Health Phys. Soc. 127-9(1957).

The design and construction of a dual ion chamber neutron detector for measurement of the fast neutron flux as found in pulsed neutron sources are described. (J.S.R.)

8630

VERSATILE FAST NEUTRON DETECTOR. J. B. McCaslin (Univ. of California, Livermore). Proc. Health Phys. Soc. 130-2(1957).

The uses and sensitivity of a proton recoil fast neutron detector are described. (J.S.R.)

8631

A LARGE BISMUTH FISSION PULSE IONIZATION CHAMBER. W. N. Hess, H. W. Patterson, and R. Wallace (Univ. of California, Berkeley). Proc. Health Phys. Soc. 133-40(1957).

A description is given of the design and construction of an ion chamber intended for health physics surveys of neutron and proton fields and for application in cosmic ray and high energy nuclear physics research. The methods of chamber design developed are applicable to the construction of any pulse ion chamber in which it is desired to have a plate area of the order of 50 sq. ft. The approximate sensitivity is 1 count per 300 very high energy neutrons/cm^2. The experimental calibrations are discussed. (J.S.R.)

8632

AN AUTOMATIC ISODOSE PLOTTING DEVICE. C. S. Simons (University Hosp., Ann Arbor, Mich.). Proc. Health Phys. Soc. 141-51(1957).

The design of an automatic isodose plotting device is discussed in some detail. The horizontal and vertical drives and the electrical drive systems are described, and the radiation probe and detection circuits are discussed. The operational sequence is given. Typical curves for the Co^{60} gamma rays in a water phantom are given. (J.S.R.)

8633

AUTOMATIC WATER SAMPLING DEVICE. C. T. Nelson and R. L. Koontz (North American Aviation Co., Downey, Calif.). Proc. Health Phys. Soc. 159-64(1957).

An automatic water sampling device used to monitor the radioactivity of liquid wastes is described. The sample rate can be varied from 100 cc or less per week to 3,000 cc per hour. The pump is self priming and requires little maintenance. (J.S.R.)

8634

THRESHOLD DETECTORS FOR LOW LEVEL NEUTRON MEASUREMENT. J. F. O'Brien (Martin Co., Baltimore). Proc. Health Phys. Soc. 231-40(1957).

A group of reactions and detectors was investigated with special emphasis on various methods of improving detector sensitivity. The detectors investigated are tabulated. The $C^{12}(n,2n)C^{11}$ and $I^{127}(n,2n)I^{126}$ reactions and the large counting area detectors, the sulfur, uranium, and bismuth detectors, are discussed in detail. (J.S.R.)

8635

A LOW PRESSURE DIFFUSION CHAMBER. A. P. Komar, M. V. Stabnikov, and D. A. Iashin (Leningrad Physico-Tech. Inst., Academy of Sciences, USSR). Soviet Phys. (Doklady) 1, 260-2(1956) May-June.

This paper was previously abstracted from the original language and appears in NSA, Vol. 10, as abstract No. 11383.

Mesons

8636 BNL-459

Brookhaven National Lab., Upton, N. Y.

SELECTED TOPICS IN LOW ENERGY PION PHYSICS. Lectures given at Purdue University. Michael J. Moravcsik. Mar. 1957. 29p. $1.00(OTS).

Discussions are included on: strong coupling theories (classical theory), weak coupling theories (relativistic theory), nonrelativistic theories, and phenomenological theories. Some features of the phenomenological approach dealt with are: energy and momentum conservation, angular momentum and parity conservation, isotopic spin, the relationship between scattering and photoproduction, and other general theorems: equivalence and low energy theorems. A comparison of theory and experiment for single pion photoproduction and the ratio of negative to positive photoproduction from deuterium are discussed. (M.H.R.)

8637

$\pi^{\pm} \rightarrow \pi^0 + e^{\pm} + \nu + 8m_e c^2$? E. Feenberg and H. Primakoff

(Washington Univ., St. Louis). Phil. Mag. (8) 3, 328-33 (1958) Apr.

The process $\pi^+ \rightarrow \pi^0 + e^+ + \nu$ has not yet been observed. Estimates of its branching ratio relative to $\pi^+ \rightarrow \mu^+ + \nu$ can be derived (1): from a phase space volume argument in conjunction with the available experimental information on π^+ and (assumed analogous) K^+ processes, and (2): from a calculation of the rate of the beta decay transition between the 'π^+' and 'π^0' states of a bound nucleon-antinucleon structure. A possible experimental scheme for detection of $\pi^+ \rightarrow \pi^0 + e^+ + \nu$ in the presence of the overwhelmingly more frequent $\pi^+ \rightarrow \mu^+ + \nu$ is outlined. (auth)

8638

V-PARTICLE PRODUCTION BY 1.9-Bev π-MESONS. G. G. Slaughter, E. M. Harth, and M. M. Block (Duke Univ., Durham, N. C.). Phys. Rev. 109, 2111-16(1958) Mar. 15.

A twenty-atmosphere hydrogen-filled diffusion cloud chamber located in a magnetic field of 10,500 gauss was exposed to a beam of 1.9-Bev π^- mesons from the Brookhaven Cosmotron. Out of 20,000 pictures taken of the chamber there are two examples of V-particle production in the gas of the chamber, and 78 examples of decays of V particles which were presumably produced in the stainless steel walls of the chamber. One of the production events in the gas of the chamber is best interpreted as $\pi^- + p \rightarrow \Lambda^0 + K^0 + \pi^0$, while the other is an example of $\pi^- + p \rightarrow \Sigma^- + K^+$ The 63 neutral decays observed include 28 identified Λ^0 particles and 11 identified θ^0 particles. Momentum and angular distributions for the Λ^0 and θ^0 particles were obtained. Six of the V^0 decays, or about 10%, were classified as anomalous. Of these, three seemed to represent the β decay of neutral V particles into $\pi^\pm + e^\pm + \nu$. From the data on neutral V-particle decays the mean lifetime of the θ_2^0 was qualitatively measured as being probably between 10^{-9} and 10^{-8} sec. The cross section for V-particle production by 1.9-Bev π^- mesons on protons is estimated to be ~ 1 mb. Some evidence was found which suggests the existence of a heavy cascade K meson which decays into a conventional K meson and a pion. (auth)

8639

MEASUREMENT OF THE SPIN-FLIP PROBABILITY IN PHOTOPRODUCTION OF NEGATIVE PIONS FROM DEUTERIUM. Kenneth C. Bandtel, Wilson J. Frank, and Richard Madey (Univ. of California, Berkeley). Phys. Rev. 109, 2117-21(1958) Mar. 15.

Negative pions photoproduced from deuterium (i.e., from the neutron) by the bremsstrahlung of the Berkeley synchrotron have been investigated by observing pion-proton coincidences. A $(CD_2)n - (CH_2)n$ subtraction yields the neutron contribution. The purpose of the investigation is to determine how often the initial triplet spin state of the deuteron changes to a singlet spin state for the two final identical nucleons in the reaction $\gamma + d \rightarrow \pi^- + p + p$. LeLevier has calculated the pion-energy spectra under two assumptions: (a) the spin state always remains the same, and (b) the spin state always changes. The experimental measurements are integrals over meson energy from a lower limit upwards, and over the time of flight between the proton and the pion, within the resolution time of the coincidence system. Thus, when the theoretically predicted spectra are folded into the experimental resolution of the equipment and the bremsstrahlung spectrum, there results a number proportional to the experimental measurement. The ratios of various experimental measurements can be compared with the theoretically predicted ratios. Within the limitations of the theory and the accuracy of the experimental measurements, the results indicate an interaction that is intermediate between the spin state's always changing and the spin state's never changing. (auth)

8640

STUDY OF THE INTERACTION OF POSITIVE K MESONS. Joseph E. Lannutti, Sulamith Goldhaber, Gerson Goldhaber, and Warren W. Chupp (Univ. of California, Berkeley) and S. Giambuzzi, C. Marchi, G. Quareni, and A. Wataghin (Istituto Di Fisica "A. Righi", Della Universita Degli Studi Di Bologna). Phys. Rev. 109, 2121-32(1958) Mar. 15.

Continuing the program on the study of positive K mesons, the interactions of K mesons with hydrogen and complex nuclei in photographic emulsions primarily in the energy interval 100 to 220 Mev were investigated. Interactions found in 320 meters of K^+ track length followed, of which 227 meters were in the energy interval 100 to 220 Mev were reported. The exposure was made to an enriched K-meson beam at the Berkeley Bevatron. The ratio of K mesons to minimum ionizing background particles ranged from 1:1 to 1:3 across our stack. Thirteen new K-hydrogen scattering events were found and added to those previously published. It was found that the K-H cross section was energy-independent in the energy interval from 20 to 200 Mev. The average cross section over this energy interval is 14.5 ± 2.2 mb. The differential cross section appears to be due predominantly to S-wave scattering. The data obtained on inelastic collisions with complex nuclei have been analyzed by using an independent-particle model for the nucleus. Using this model and correcting for (a) nucleon shading, (b) Coulomb repulsion, (c) Pauli exclusion principle, and (d) repulsive potentials, we obtained the average K-nucleon cross section as a function of energy. This cross section appears energy-independent in the energy interval 60 to 180 Mev. The values for the elementary cross sections obtained in this analysis for $T_K = 60$ to 180 Mev with $V = V_N + V_C = 35$ Mev were $\bar{\sigma}$ (the average K-nucleon cross section) = 11.8 ± 1.3 mb, $\sigma_{KN} = 9.8 \pm 3.0$ mb (with $\sigma_{Kn} = \sigma_n^+ + \sigma_n^0$ where σ_n^+ is direct neutron scattering and σ_n^0 is charge-exchange scattering), $\sigma_n^+ = 5.8 \pm 3.1$ mb, and $\sigma_n^0 = 4.0 \pm 0.8$ mb. In this case the ratio $\sigma_{Kp} : \sigma_n^+ : \sigma_n^0 \approx 3.6 : 1.5 : 1$. We observe a backward peaking in the differential cross section and believe that this is due to a small P-wave contribution. These results lead to the conclusion that the K-nucleon scattering is a short-range force interaction and does not proceed through single π-meson exchange. The latter would require high-angular-momenta contributions and would presumably result in a strongly energy-dependent cross section. A repulsive potential was necessary to explain the behavior of the fractional energy loss as a function of energy. The magnitude of the potential necessary for a best fit $V \approx 30$ Mev agrees very well with the results of a partial wave analysis of the elastic-scattering data. (auth)

8641

SCATTERING OF K^+ MESONS IN EMULSION. George Igo, D. Geoffrey Ravenhall, and Jerome J. Tiemann (Stanford Univ., Calif.), Warren W. Chupp, Gerson Goldhaber, Sulamith Goldhaber, and Joseph E. Lannutti (Univ. of California, Berkeley), and Roy M. Thaler (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 109, 2133-40(1958) Mar. 15.

Some new experimental results on the scattering of K^+ mesons in emulsion are presented, in two energy ranges, $T_K = 40$ to 100 Mev and $T_K = 150 \pm 30$ Mev. An optical-model analysis is made of these results, which avoids many of the approximations of previous workers. It is concluded that the K^+-nucleus iteration is repulsive and that the K^+-nucleon cross section inside the nucleus is compatible with the observed cross section for free protons. (auth)

8642

K-MESON CONTRIBUTION TO FORCES BETWEEN

BARYONS. D. B. Lichtenberg and Marc Ross (Indiana Univ., Bloomington). Phys. Rev. 109, 2163-9(1958) Mar. 15.

A fourth-order perturbation theory calculation is made of baryon-baryon forces arising from the exchange of K mesons. Results are compared with experiment. If it is assumed that the K meson is coupled equally to all baryons, while the pion is coupled weakly to hyperons, it is found (for either scalar or pseudoscalar K) that the Λ-nucleon potential does not have the right spin dependence to give agreement with binding energies in hyperfragments. If, on the other hand, it is assumed that the pion is coupled with the same strength to all baryons, then one can obtain agreement with experiment if the baryon-baryon potentials arising from K exchange are small. This is not inconsistent with fairly large K coupling constants. These conclusions, however, become tenuous if K-baryon couplings are as strong as the π-nucleon coupling (for example, if the PS coupling constants are comparable). (auth)

8643

CALCULATION OF THE ANOMALOUS MAGNETIC MOMENTS OF THE Λ^0 AND THE Σ^0, Σ^+, Σ^- HYPERONS. Michael Nauenberg (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 109, 2177(1958) Mar. 15.

A field-theoretic perturbation calculation of hyperon anomalous magnetic moments due to K mesons has been made under the assumption that the coupling constant is small. The effect of baryon and strangeness conservation is to suppress some of the Feynman diagrams that appear in the analogous calculation of nucleon anomalous magnetic moments due to π mesons, and leads to the relation between the anomalous magnetic moments of the Σ hyperons found by Marshak, Okubo, and Sudarshan. (auth)

8644

METHOD FOR DETERMINING THE $\theta_1-\theta_2$ MASS DIFFERENCE. W. F. Fry and R. G. Sachs (Univ. of Wisconsin, Madison). Phys. Rev. 109, 2212-13(1958) Mar. 15.

The existence of a neutral K meson of long lifetime and mixed strangeness, as suggested by Gell-Mann and Pais, has been well established. The ideas of these workers lead to other effects such as the interference between θ_1 and θ_2 states during the lifetime of the particles. Furthermore the masses of the particles designated as θ_1 and θ_2 should be slightly different. One method to observe the interference phenomenon and thereby measure the mass difference has been suggested by Treiman and Sachs. The purpose of this discussion is to call attention to another method of detection which does not utilize the decay properties but rather depends upon the direct detection of the θ and $\bar{\theta}$ modes. (A.C.)

8645

EVIDENCE FOR THE PRODUCTION OF A NEUTRAL PION IN AN ANTIPROTON ANNIHILATION EVENT. Glenn M. Frye, Jr. and Alice H. Armstrong (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 110, 170-2(1958) Apr. 1.

An antiproton of kinetic energy 110 Mev annihilates in flight, producing a star in nuclear emulsion with 3 charged mesons and 4 heavier particles. An electron-positron pair is found, 76 μ from the vertex and closely aligned with it. The pair is best explained as resulting from a γ ray from the decay of a π^0 meson which was formed in the annihilation. The most likely interpretation of the event is that the antiproton annihilated with a proton in N^{14} or O^{16} with the production of two positive pions, a neutral pion and a negative pion all of which escaped the nucleus; and a negative pion which was absorbed. The pion energies, including $m_\pi c^2$, are as follows (in Mev): π^+, 214 ± 2; $\pi^\pm$, 635 ± 138; $\pi^\pm$, 628 ± 131; π^0, $190 < E_{\pi^0} < 400$; π^-, $290 < E_{\pi^-} < 480$. (auth)

8646

INTERACTION OF 1.5-Bev NEGATIVE π MESONS WITH EMULSION NUCLEI. J. E. Crew and R. D. Hill (Univ. of Illinois, Urbana). Phys. Rev. 110, 177-84(1958) Apr. 1.

The energy spectrum of charged pion secondaries, produced from emulsion nuclei by bombardment with 1.5-Bev negative pions, has been measured. The spectrum was observed to be sharply peaked for pions of laboratory energies from 100 to 150 Mev. The mean pion energy was 148 Mev, and 75% of the pions were in the energy range from 50 to 150 Mev. The observed number of charged pions per star was 0.66. Half of the emulsion stars had no meson track, 36% had a single meson, 12% two mesons, and 2% more than two mesons. The experimental results have been compared with Monte Carlo nuclear cascade calculations. (auth)

8647

ASSOCIATED PRODUCTION OF Σ^0 AND θ_2^0; MASS OF THE Σ^0. F. Eisler, R. Plano, N. Samios, and J. Steinberger (Columbia Univ., New York and Brookhaven National Lab., Upton, N. Y.), and M. Schwartz (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 110, 226-7(1958) Apr. 1.

An event in which θ_2^0 and Σ^0 production and decay are both observed, is described. This event yields a mass value for the Σ^0 and demonstrates the associated production of the θ_2^0. Additional events yielding mass values of the Σ^0 are reported. (auth)

8648

π^--P INTERACTION IN HIGH ENERGY REGION. Daisuke Ito, Tetsuro Kobayashi, Miwae Yamazaki, and Shigeo Minami (Tokyo Univ. of Education and Osaka City Univ.). Progr. Theoret. Phys. (Kyoto) 18, 264-8(1957) Sept.

It is shown that the elastic and total cross sections for π^--p collision above 1.0 Bev can almost be explained as the shadow effect of the inelastic collision. Based on this result, whether or not the second maximum of the total cross section for this reaction can be interpreted in terms of inelastic scattering is discussed. (auth)

8649

PION PRODUCTION IN NUCLEON-NUCLEON COLLISIONS IN Bev RANGE. Tetsuro Kobayashi (Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto) 18, 318-20(1957) Sept.

The consistency of the cross section of pion production in nucleon-nucleon collisions in the Bev range with the cross section of the corresponding pion-nucleon scattering is examined in this note. (A.C.)

8650

ANOMALOUS MAGNETIC MOMENTS OF HYPERONS AND MIRROR THEOREM. Hiroshi Katsumori (Iowa State Coll., Ames). Progr. Theoret. Phys. (Kyoto) 18, 375-82(1957) Oct.

According to the theory of d'Espagnat and Prentki the anomalous magnetic moments of hyperons are calculated in the lowest-order perturbation approximation. It is further shown that their charge-independent interaction Hamiltonian leads to the mirror theorem for the anomalous magnetic moments of baryons (and of K mesons) without use of perturbation approximation. Finally the anomalous magnetic moments of Σ hyperons determined from the mass differences of Σ and the mirror theorem are compared with the perturbation results. (auth)

8651

DIFFERENTIAL CROSS SECTION FOR PHOTOPRODUCTION OF π-MESONS ON NUCLEONS TAKING ACCOUNT OF d-STATES. N. F. Nelipa (P. N. Lebedev Physics Inst., Academy of Sciences, USSR). Soviet Phys. JETP. 6, 210-11(1958) Jan.

An expression is given for the differential cross section for the photoproduction of π mesons on nucleons in the s, p, and d states. All possible transitions associated with the photoproduction of π mesons and the interference between them are taken into account. (J.S.R.)

8652

THEORY OF THE PRODUCTION OF ELECTRON-POSITRON PAIRS IN COLLISIONS OF SLOW μ^--MESONS WITH NUCLEI. L. M. Afrikian (Inst. of Physics, Academy of Sciences, Armenian SSR). Soviet Phys. JETP. 6, 217-18(1958) Jan.

Results of calculations are presented which have been carried out for the threshold region for the production of electron-positron pairs in the collision of μ^- mesons with nuclei. The total cross section for the pair production is given for two cases. (J.S.R.)

8653

DECAY PROBABILITIES OF THE Σ-HYPERON WITH PARITY NONCONSERVATION. I. Iu. Kobzarev and L. B. Okun'. Soviet Phys. JETP. 6, 230-1(1958) Jan.

On the assumption that in the decay of the Σ hyperon the selection rule $\Delta T = \frac{1}{2}$ (where T is the isotopic spin) is valid, invariance under time inversion is maintained, and parity is conserved, it has been shown that the quantities $X = \omega^0/\omega^+$ and $Y = \omega^-(\omega^+ + \omega^0) = \tau^+/\tau^-$ (where $\tau^\pm$ is the lifetime of the hyperon) should lie on a curve depending on the spin and parity of the Σ hyperon. Alvarez (Phys. Rev. 105, 1127(1957)), because the X, Y point did not lie on the theoretical curves in results obtained by him, questioned the validity of the selection rule. It is shown that the data of Alvarez lie in the allowed region if parity is not conserved, and therefore do not contradict the assumption of the validity of the selection rule. (J.S.R.)

8654

ANOMALOUS DECAY OF A CHARGED PARTICLE OBSERVED IN A CLOUD CHAMBER. Z. Sh. Mandzhavidze, N. N. Roinishvili, and G. E. Chikovani (Physics Inst., Academy of Sciences, Georgian SSR). Soviet Phys. JETP. 6, 236-7(1958) Jan.

A cloud-chamber observation was made of a slow particle with an ionization multiplicity factor greater than twenty entering the chamber and emitting, at an angle of 95°, a positive particle with momentum 352^{+94}_{-61} Mev/c and close to minimum ionization. The transverse component of the secondary particle momentum is 351 Mev/c, which is much larger than the maximum momentum of the decay products in the rest system for all known decay schemes of hyperons and K mesons. Kinematic analysis excluded the possibility of interpreting the event as the decay of a Λ^0, Θ, or V_3^0 particle. It is assumed that observation was made of the decay of a particle heavier than a K meson. (J.S.R.)

8655

CAPTURE OF POLARIZED μ^--MESONS BY NUCLEI. B. L. Ioffe. Soviet Phys. JETP. 6, 240-2(1958) Jan.

From the interaction Hamiltonian of the capture of a completely polarized μ^- meson by a nucleus, the matrix element is calculated, and the square of the matrix element is obtained. The common case of the capture of the μ^- meson leading to a neutron and a recoil nucleus is considered and the square of the matrix element is derived. From the expression derived it is concluded that when the capture process gives rise to neutrons whose momentum is in the direction opposite to that of the neutrino, these neutrons are directed primarily along (or against) the μ^- meson spin and their angular distribution is given by the expression $dW/d\Omega = 1-\beta\cos\theta$ where θ is the angle between the direction of motion of the neutron and the μ^--meson spin. For scalar, vector, and pseudoscalar interactions $\beta = 1$. For the tensor and axial vector interactions $\beta = -\frac{1}{3}$. (J.S.R.)

8656

ON THE POSSIBLE EFFICIENCY OF THE CATALYSIS OF NUCLEAR REACTIONS BY MESONS. Ia. B. Zel'dovich (P. N. Lebedev Physical Inst., Academy of Sciences, USSR). Soviet Phys. JETP. 6, 242-3(1958) Jan.

There is experimental evidence of the ability of negative mesons to catalyze a nuclear reaction between two singly charged ions (p, d, t) by bringing the reacting nuclei closer together. The probability of binding was calculated by a method developed by Migdal (Zhur. Eksptl'. i Teoret. Fiz. 9, 1163(1939)) in treating the probability that an atom is ionized during beta decay. It is shown that mesons (or heavier mesons) will not be stripped from the helium nucleus by electron collisions. The probability that a meson enters an excited state near the helium nucleus is small compared with the probability that it remain in the ground state. (J.S.R.)

8657

BREMSSTRAHLUNG OF π-MESONS AND PRODUCTION OF π-MESON PAIRS BY γ-QUANTA IN COLLISIONS WITH NONSPHERICAL NUCLEI. I. T. Dyatlov (Leningrad Inst. of Physics in Tech.). Zhur. Eksptl'. i Teoret. Fiz. 34, 80-6(1958) Jan. (In Russian)

Effective cross sections are computed for a number of radiative processes arising in the interaction of high-energy π mesons with nonspherical nuclei. Nonsphericity of the nuclei modifies the angular distributions and leads to the appearance in the cross sections of factors which are dependent only on the geometrical shape of the nucleus. (tr-auth)

8658

PHOTO-PRODUCTION OF STRANGE PARTICLES ON PROTONS. V. I. Mamasakhlisov, S. G. Matinyan, and M. E. Perelman (Inst. of Physics, Ačademy of Sciences, Georgian SSR). Zhur. Eksptl'. i Teoret. Fiz. 34, 195-7 (1958) Jan. (In Russian)

Photo-production of strange particles on protons is considered for the case of hyperon spins of $\frac{1}{2}$ and $\frac{3}{2}$. The angular distribution of K mesons is derived. Comparison of these distributions with experiment permits one to determine the parity of the (KY)-system with respect to the nucleon. (tr-auth)

8659

CROSS SECTIONS OF π-MESON INTERACTIONS WITH CARBON NUCLEI. V. T. Osipenkov and S. S. Filippov (Joint Inst. of Nuclear Research). Zhur. Eksptl'. i Teoret. 34, 224-6(1958) Jan. (In Russian)

The integral effective cross sections of elastic and inelastic interactions of mesons at 0 to 3 Mev with carbon nuclei were calculated on the basis of the R. M. Frank (Phys. Rev. 101, 891(1956)) formula. (R.V.J.)

Microwaves

8660 AECU-3672

Illinois. Univ., Urbana. Electrical Engineering Research Lab.

RESEARCH AND INVESTIGATION LEADING TO METHODS OF GENERATING AND DETECTING RADIATION IN THE 100 TO 1000 MICRON WAVELENGTH RANGE OF THE SPECTRUM. Quarterly Progress Report No. 8 [for] December 1, 1957 to March 1, 1958. P. D. Coleman, R. C. Becker, R. J. Kenyon, H. A. Spuhler, J. J. Stafford, and A. W. Swage. Mar. 15, 1958. 59p. Contract AT(11-1)-392. $9.30(ph OTS); $3.60(mf OTS).

The behavior of the slow-wave dielectric resonator was studied for several values of the dielectric constant in the cylinder material. Design curves and mode plots for ϵ/ϵ_0 of 1.30 and 1.05 are included. Signals from the DX-151 four-millimeter klystron are shown. (For preceding period see AECU-3626.) (M.H.R.)

Molecular Properties

Refer also to abstract 8340.

8661

SECOND ORDER SUM RULE FOR THE VIBRATIONS OF ISOTOPIC MOLECULES AND THE SECOND RULE OF THE MEAN. Jacob Bigeleisen (Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys. 28, 694-9(1958) Apr.

A second-order sum rule for the vibrational frequencies of isotopic molecules is derived. The rule relates the second power of the λ's, $\Sigma\lambda_i^2$ and $\Sigma_{i\neq j}\lambda_i\lambda_j$, for isotopic molecules of the type $X'Y_{z-r}Y'_r$ and $XY_{z-r}Y'_r$ with the second power of the λ's for the symmetrical molecules $X'Y'_z$, XY'_z, $X'Y_z$, and XY_z. Special consideration is given to the case where X' and X are in fact Y' and Y in positions structurally equivalent to the z Y atoms in XY_z. In the latter case, if z is greater than 2, the rule may involve isotopic isomers. Just as in the case of the first-order sum rule, the second-order rule can be applied separately to the individual symmetry classes common to all of the molecules. It is shown that the second-order sum rules for a homologous series of isotopic molecules can be found easily by a simple tabulation of the interactions between the equivalent isotopic atoms. Interaction tables are given for the deutero-ethylenes and the deutero-benzenes. The second-order sum rule is used to derive the second rule of the mean for isotopic exchange equilibria. Examples of the latter are given involving the carbon dioxide, ethylene, and benzene molecules. (auth)

Neutrons

Refer also to abstract 8587.

8662 ORNL-2485

Oak Ridge National Lab., Tenn.

ON KOFINK'S APPROXIMATE SOLUTION OF THE NEUTRON TRANSPORT EQUATION. Ky Fan and J. J. Andrews. Apr. 10, 1958. 40p. Contract W-7405-eng-26. $1.25(OTS).

Recently the spherical harmonics method has been applied for obtaining approximate solutions of the neutron transport equation. A mathematically rigorous exposition is presented of the main part of Kofink's work and is self-contained. Rigorous proofs in certain derivations are supplied making it explicit and precise under what hypothesis the results are valid. The approximate solutions of the Boltzmann equation are described and their behavior examined. The zeros of certain polynomials G_n are investigated and certain coefficients α_1 are calculated. (W.D.M.)

8663

SPHERICAL-HARMONICS METHOD FOR NEUTRON TRANSPORT THEORY PROBLEMS WITH INCOMPLETE SYMMETRY. B. Davison (Univ. of Toronto, Ont., Can.). Can. J. Phys. 36, 462-75(1958) Apr.

The application of the spherical-harmonics method to neutron-transport problems is dealt with in which the geometrical arrangement possesses spherical or cylindrical symmetry, but the distribution of sources and/or the conditions at infinity lack such symmetry. Certain classes of cases of this nature are considered, and for these, in an arbitrary-order approximation, the solution is given, in closed form, in terms of a finite number of Bessel functions. (auth)

8664

HEAVY MODERATOR APPROXIMATIONS IN NEUTRON TRANSPORT THEORY. Harvy Amster (Bettis Atomic Power Div., Pittsburgh). J. Appl. Phys. 29, 623-7(1958) Apr.

The flow of neutrons slowing down into a given angular and lethargy (or energy) interval equals an integral over the contributions from neutrons at other angles and lethargies within the medium. The two angular dependences of the integrand are commonly expanded in Legendre polynomials, and for heavy moderators, the lethargy dependence being integrated over is expanded in a power series about the lethargy of the exit neutrons. For each of these three expansions there is an index whose effect on the rate at which the resulting coefficients $T_{LL'}^n$ vanish with increasing moderator mass is found. These estimates indicate where to terminate the lethargy expansions of the components of the current so as to maintain a consistent order of accuracy for each, and the sensitivity of the approximations to individual Legendre coefficients of the scattering cross sections follows. Exact recursion formulas derived for the $T_{LL'}^n$ contain infinite sums, which can be terminated such that the uncertainty in the terms retained in the transport theory approximations are no larger than the estimated values of terms neglected. The familiar "consistent P1 approximation" is generalized as a particular example, and it is shown to be sensitive to only the first three Legendre coefficients of the cross section. The Greuling-Goertzel approximation is also generalized and its merits noted. The associated difficulties in treating recoil due to inelastic scattering are discussed. (auth)

8665

FAST NEUTRON ATTENUATION IN GRAPHITE. V. P. Duggal and S. M. Puri (Atomic Energy Establishment, Trombay, Bombay). J. Appl. Phys. 29, 675-9(1958) Apr.

Spatial distribution of a fast neutron flux has been measured experimentally in graphite (density 1.62 g/cc) using threshold radioactivants. For these measurements neutrons were obtained from D-T and D-Be reactions. Assuming the neutron flux to vary as $1/R^2e^{-R/L}$, the values of relaxation length L (between 50 cm and 70 cm) obtained with a phosphorous detector from D-T and D-Be neutrons are 23.5 ± 1.5 cm and 19.7 ± 1.0 cm, respectively. It is also seen that fast flux falls off less rapidly than resonance neutron (1.46 ev) flux after about 50 cm in graphite. The spatial distribution of neutrons between the energies 1 Mev to 3 Mev from a plane monoenergetic source of 3-Mev neutrons has also been obtained using a Monte-Carlo calculation. (auth)

8666

SOME PROBLEMS OF APPLICATION AND PRACTICAL DESIGN OF NEUTRON AMPLIFIERS. I. A. Neszmélyi and K. Simonyi (Polytechnical Univ., Budapest). Periodica Polytechnica Elec. Eng. 1, 73-88(1957).

Calculations concerning the value of multiplication to be obtained in static neutron-multiplying systems using different quantities of variously enriched fissionable material and several types of geometrical layouts and reflectors are presented. The economic and safety aspects of these systems are also considered. (auth)

8667

NEUTRON YIELDS FROM THICK TARGETS BOMBARDED BY 18- AND 32-Mev PROTONS. Yuin-Kwei Tai, George P. Millburn, Selig N. Kaplan, and Burton J. Moyer (Univ. of

California, Berkeley). Phys. Rev. 109, 2086-91(1958) Mar. 15.

Neutron yields from thick targets bombarded by 32- and 18-Mev protons were measured for 59 elements and compounds. For 23 metallic elements, yields were also measured from targets thick enough to degrade the proton energy from 32 to 18 Mev. The neutrons were detected by counting the Mn^{56} activity produced by neutron capture in $MnSO_4$ solution contained in a 3-ft by 3-ft tank that surrounded the targets. The efficiency of the neutron-detection system was determined with a calibrated Ra-α-Be source. For all three energy intervals, the neutron yields increased abruptly at Z = 20 and Z = 30, and Ni had a yield $\frac{1}{3}$ that of neighboring elements. The yields were compared with calculations based on the statistical theory of nuclear reactions. The agreement was fair for Z > 30, but the calculated yields did not reproduce the sudden jump at Z = 30. (auth)

8668

MANY-PHONON PROCESSES IN CRYSTALS. V. F. Turchin. Soviet Phys. JETP. 6, 96-102(1958) Jan.

We have calculated the differential cross section for the inelastic scattering of a neutron by a crystal with either emission or absorption of an arbitrary number of phonons. The first case is of interest when the temperature of the crystal is low, and the second when the neutron energy is very small and the crystal temperature sufficiently high. Formulas are obtained for crystals with an arbitrary spectrum of the normal vibrations. If we choose a specific spectrum, the calculations can be pursued to the end, leading to a simple final formula. We have also given the formula for the limiting case of the scattering of high energy neutrons by a free nucleus. (auth)

8669

SMALL-ANGLE SCATTERING OF FAST NEUTRONS BY HEAVY NUCLEI. Iu. A. Aleksandrov (Atomic Energy Inst.). Soviet Phys. JETP. 6, 228-30(1958) Jan.

The angular distribution of fast neutrons elastically scattered from Pu, U, Pb, Bi, Sn, and Cu nuclei was studied in the interval of angles from 4 to 25°. The results, corrected for the Schwinger scattering cross section, are graphed. (J.S.R.)

8670

ON THE POLARIZATION OF SLOW NEUTRONS SCATTERED IN CRYSTALS. S. V. Maleev (Leningrad Inst. of Physics in Tech.). Zhur. Eksptl'. i Teoret. Fiz. 34, 129-30(1958) Jan. (In Russian)

Formulas were derived for the cross sections and polarization of slow neutrons scattered in crystals with polarized nuclei. (tr-auth)

8671

PILE NEUTRON RESEARCH. D. J. Hughes. Cambridge, Addison-Wesley Publishing Company, Inc., 1953. 395p. $10.00.

The fundamental interactions of neutrons with matter are discussed. The object is not to present a mathematical development of these interactions, but to give a clear physical picture of neutron cross sections and such neutron phenomena as diffusion and moderation, that are based on cross sections. The mathematics is limited to that necessary in the explanation of the physical principles involved and for the later description of experimental pile research. The physical principles of the chain-reacting pile are treated, again using only the necessary mathematics. The physical basis for the distribution of the neutrons in energy and in position in the pile is presented. The common types of piles are described, as well as the general facilities for research that are available with them. The methods of determining neutron source strengths and fluxes are covered. The research techniques that have been developed are considered in the order of neutron energy, beginning with "fast" neutrons, of energy 1 to 14 Mev, continuing with the intermediate or "resonance" energy region extending down to 1 ev, and concluding with the field of slow (below 1 ev) neutrons. The new instruments unique to piles ("choppers," crystal spectrometers, and neutron mirrors) are covered in detail. A short discussion of the measurement of radiation intensity in terms of the effect on living tissue, and the methods for avoiding radiation damage is given. A complete table of slow neutron (thermal) cross sections, based on a critical evaluation of all experimental data on coherent and incoherent scattering, absorption, and activation cross sections, is included in an appendix. Those constants, conversion factors, formulas, and mass values that are frequently needed in connection with neutron research are also collected in an appendix for convenient reference. (M.H.R.)

Nuclear Physics

8672 IFA-FT-22

Academia R. P. R. Institutul de Fizică Atomică, Bucharest.

ON PAIR CREATION BY CHARGED PARTICLES IN AN EXTERNAL FIELD. (Asupra Generării de Perechi de Către Particulele Încărcate Într-un Cîmp Exterior.) C. Eftimiu and M. E. Mayer. 1956. 13p.

Calculated cross sections for pair creation by charged particles are in apparent disagreement with one another and with part of the available experimental data on trident showers. These cross sections are reinvestigated by the covariant graphical technique. Expressions are given for the differential cross sections for pair creation by spin $\frac{1}{2}$ particles and by charged spin particles. (M.H.R.)

8673 IFA-R-27

Academia R. P. R. Institutul de Fizică Atomică, Bucharest.

ON THE POSSIBILITY OF NUCLEAR CHAIN REACTIONS IN LIGHT ELEMENTS. (Asupra Posibilităţii Reactiilor Nucleare in Lant cu Elemente Usoare). E. Larisch and I. Shechtman. 1957. 14p.

The elements situated at both ends of the periodic table are capable of producing exothermic nuclear reactions. In the heavy elements this process takes place by fission while in the light ones by fusion. The processes of the first type are currently used in nuclear reactors. The reactions of the second type are used at present only in thermonuclear bombs. Since fusion reactions give birth to high-energy particles the question arises whether, by using the latter, it would be possible to maintain a chain process. This study deals with this problem. The results of the investigation are negative, and it is concluded that it is improbable that other reactions will be found with light elements which can be started and maintained as chain reactions. (A.C.)

8674 LA-1875(Del.)

Los Alamos Scientific Lab., N. Mex.

SAFETY TESTS FOR THE STORAGE OF FISSILE UNITS. E. C. Mallary, K. C. Paxton, and R. H. White. Feb. 1955. 39p. Contract W-7405-eng-36. $1.25(OTS).

Neutron multiplication measurements made on cubic lattices of fissile units inside cubic concrete vaults are reported. The inner dimensions of the concrete vaults ranged from 1 to 5 feet, and the dimensions of the lattices were changed accordingly. Where safety considerations of the test allowed, as many as 27 of the fissile units were used in the lattice. Tests also were made to determine tamping effect of the 1-foot thick vault walls and ceiling and the effect of impurities such as blocks of paraffin or the presence of boron plastic within the lattice of fissile units. (auth)

8675 ORNL-1261(Del.)
Oak Ridge National Lab., Tenn.
SOLID STATE DIVISION QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1952. J. T. Howe, ed. Oct. 9, 1952. Decl. with deletions Feb. 21, 1957. 47p. Contract W-7405-eng-26. $7.80(ph OTS); $3.30(mf OTS).

Progress is reported on the following projects: position of bombardment-produced energy levels in Ge, stored-energy measurements at elevated temperatures, use of retrogression phenomena to resolve particles affecting resistivity from those affecting hardness, effect of irradiation on subsequent aging of Cu–Ti alloy, creep under irradiation, impact tests on irradiated steel, physical properties of irradiated plastics and elastomers, measurement of neutron energy spectra, correlation of neutron bombardment with proton bombardment, and tests on graphite-UO_2 bars. (L.T.W.)

8676 ORNL-1829(Del.)
Oak Ridge National Lab., Tenn.
STABLE ISOTOPE RESEARCH AND PRODUCTION DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING NOVEMBER 20, 1954. Feb. 18, 1955. Decl. with deletions Feb. 21, 1957. 54p. Contract W-7405-eng-26. $10.80(ph OTS); $3.90(mf OTS).

Progress is reported on the following studies: microwave spectrum of vinyl iodide and the Raman spectra of H_2CO, F_2CO, D_2COF, and DCOF; infrared spectra of simple tritium compounds; the optical system of the microphotometer; 3.4-m Ebert spectrograph using a 7500 line per inch plane grating; isotopic structure of 8 separated Cd isotope samples; high-resolution recording interferometer; Stark-effect studies in hollow cathode sources; diagram of spectrum assay produced by an Echelle-Littrow spectrograph; spectrochemical analysis of rare earths; chemical analysis by x-ray absorption and fluorescence; x-ray-diffraction analysis of $PbUO_4$ and UO_2HAsO_4; percentage composition of U in reactor fuels and in samples of sea water; data that will improve the half life and neutron cross section determination of Cs^{135}; the occurrence of Tc^{98} in Mo ores; U burnup by isotope abundance method; design and performance of a vibrating reed preamplifier; stable isotope separation and production; and calutron operations. A summary of isotope shipments is presented. (J.E.D.)

8677
YIELDS OF Sr^{90} AND Sr^{88} IN REACTOR NEUTRON FISSION OF Pu^{239}. L. M. Krizhanskii and A. N. Murin. Atomnaya Energiya 4, 77-9(1958) Jan. (In Russian)

A mass spectrometric determination was made of the Sr^{88} and Sr^{90} yields from Pu^{239} irradiated by an integral flux of 2.7×10^{20} nvt of slow neutrons. (R.V.J.)

8678
CENTER-OF-MASS MOTION IN BRUECKNER THEORY FOR A FINITE NUCLEUS. Harry J. Lipkin (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev. 109, 2071-2 (1958) Mar. 15.

Center-of-mass motion, generally not considered in the Brueckner theory, can cause divergences in the case of a finite nucleus. A possible way of avoiding this difficulty is presented. (auth)

8679
INTRINSIC QUADRUPOLE MOMENT AND THE RESONANCE WIDTH OF PHOTONUCLEAR REACTIONS. K. Okamoto (Louisiana State Univ., Baton Rouge). Phys. Rev. 110, 143-53(1958) Apr. 1.

The correlation between nuclear deformation and the resonance width of photonuclear reactions is discussed. The general trend of the nuclear deformation is in good agreement with the predictions of Marumori, Suekane, and Yamamoto, and the existence of the correlation is clarified. The calculation assuming the splitting of the resonance and a constant width for spherical nuclei agrees qualitatively with experiments, but quantitatively the calculated values are too low, especially for strongly deformed nuclei. For light nuclei the quantatitive calculation has little meaning, but a similar correlation is found for them. The mass-number dependence of the resonance width is discussed qualitatively; it turns out that the variation of this width arises from various causes and is not a simple function of mass number. A discussion of the nuclear shape in the highly excited state (~20 Mev) is given, and it is shown that this nuclear shape may not be very different from the shape in the ground state. (auth)

8680
PRODUCTION OF He^6 BY HIGH-ENERGY PROTONS. F. S. Rowland and R. L. Wolfgang (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 110, 175-7(1958) Apr. 1.

Excitation functions have been obtained for the production of He^6 in the interactions of high-energy protons with various targets. The cross sections rise with increasing energy and increasing Z, varying between 0.5 mb for C at 1.0 Bev and 29 mb for Pb at 3.0 Bev. (auth)

8681
MONTE CARLO CALCULATIONS ON INTRANUCLEAR CASCADES. I. LOW-ENERGY STUDIES. N. Metropolis, R. Bivins, and M. Storm (Los Alamos Scientific Lab., N. Mex.), Anthony Turkevich (Univ. of Chicago), J. M. Miller (Columbia Univ., New York), and G. Friedlander (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 110, 185-203(1958) Apr. 1.

Nuclear cascade calculations of the Goldberger type have been performed using the MANIAC electronic computer. A three-dimensional relativistic treatment was used. The target nuclei were Al^{27}, Cu^{64}, Ru^{100}, Ce^{140}, Bi^{209}, and U^{238}. Incident protons and neutrons with energies between 82 and 365 Mev have been studied, but meson production was neglected in this energy range. Cascades initiated by about 1000 incident particles were followed in each case. The results have been compared with those of previous calculations of this type, as well as with experimental photographic-plate data and counter measurements reflecting the cascade stage of high-energy nuclear reactions. The agreement with experimental data is usually good. Tables and graphs are presented showing the frequency of occurrence of various residual nuclei, and data on the residual nuclear excitation energy after the cascade are over. A few comparisons with radio-chemical data indicate over-all agreement with the general spallation pattern of copper with 340-Mev protons and good agreement with the $Ni^{64}(p,n)Cu^{64}$ reaction over the energy range 100 to 400 Mev. However, the calculated results for the $Cu^{65}(p,pn)Cu^{64}$ reaction are low by almost a factor of two, although the energy dependence is approximately correct. (auth)

8682
MONTE CARLO CALCULATIONS ON INTRANUCLEAR CASCADES. II. HIGH-ENERGY STUDIES AND PION PROCESSES. N. Metropolis, R. Bivins, and M. Storm (Los Alamos Scientific Lab., N. Mex), J. M. Miller (Columbia Univ., New York), G. Friedlander (Brookhaven National Lab., Upton, N. Y.), and Anthony Turkevich (Univ. of Chicago). Phys. Rev. 110, 204-19(1958) Apr. 1.

The nuclear cascade calculations described in the preceding paper have been extended to incident energies up to 1.8 Bev with the inclusion of pion production, scattering, and absorption processes. Again the MANIAC electronic computer was used. Several incident proton energies between 450 Mev and 1.8 Bev have been investigated,

with Al^{27}, Cu^{64}, Ru^{100}, Ce^{140}, Bi^{209}, and U^{238} as target nuclei. Cascades initiated by pions of several energies up to 1500 Mev incident on Ru^{100} have also been studied. The elementary cross sections used and the assumptions made about details of the inelastic nucleon-nucleon and pion-nucleon processes are presented. The results of the calculation are summarized in tables and graphs giving data on transparencies, on numbers, energy spectra, and angular distributions of emitted cascade nucleons and pions, and on frequencies of occurrence and excitation energies of residual nuclei. The computed number of distributions, energy spectra, and angular distributions of emitted particles are compared with the results of several emulsion experiments with incident protons and negative pions. The agreement is generally satisfactory, but certain discrepancies are found, for example regarding spectra and angular distributions of emitted pions; some of these discrepancies are discussed in terms of details of the model used. The calculation predicts quite well the over-all yield distribution of spallation products of copper produced by 2-Bev protons; however, as at lower energies, the calculated cross sections for (p,pn) reactions are too low by factors of two or three. (auth)

8683

INNER BREMSSTRAHLUNG AND THE MAGNETIC MOMENT OF THE NEUTRINO. Wallace Gold and Larry Spruch (New York Univ.). Phys. Rev. 110, 290-1(1958) Apr. 1.

Recent decay developments have renewed interest in the question of whether the neutrino magnetic moment and mass are small or zero. The possibility of detecting the magnetic moment through inner bremsstrahlung is considered. (A.C.)

8684

THE ELECTRIC-OCTUPOLE TRANSITIONS OF NUCLEI. Mitsuo Sano (Univ. of Tokyo). Progr. Theoret. Phys. (Kyoto) 18, 223-34(1957) Sept.

The j-forbidden electric octupole transitions of nuclei are explained on the basis of configuration mixing. The main contributions to the matrix element of the j-forbidden electric octupole transitions come from a proton transition for odd proton nuclei, and from both proton and surfon transitions for odd neutron nuclei. In the case of a proton transition, the allowed matrix element is of the first order for odd proton nuclei. For odd neutron nuclei, the mixing of proton configuration must be taken into account. The matrix element for a proton transition is of the second order. The allowed matrix element for a surfon transition is also of the second order. The calculations are based upon the perturbation theory. The agreement between the calculated and observed lifetimes are qualitatively good. (auth)

8685

HIGHER APPROXIMATIONS IN THE SELF-CONSISTENT FIELD METHOD OF MESON THEORY. E. L. Feinberg and D. S. Chernavskii (P. N. Lebedev Physics Inst., Academy of Sciences, USSR). Soviet Phys. (Doklady) 1, 354-7(1956) May-June.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 555.

8686

ON THE THEORY OF THE EXCITATION ENERGY OF HEAVY NUCLEI. L. P. Rapoport and Iu M. Butusov (Voronezh State Univ.). Soviet Phys. (Doklady) 1, 387-91 (1956) May-June.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 804.

8687

NUCLEAR SUBSHELLS AND DEFORMATION IN THE REGION PAST LEAD. N. N. Kolesnikov and A. P. Krylova (Moscow State Univ.). Soviet Phys. JETP. 6, 212-14(1958) Jan.

An investigation was made to determine with which N and Z numbers nuclear deformation effects are to be associated, whether or not any of the subshells are filled in the heavy nucleus range, and the energy associated with filling of the subshells and the effect of deformation. The energy increments required to add neutrons and protons was considered and singularities were noted in the energies at N = 130, 136, 144, and 152 for neutron addition and at Z = 86, 92, and 96 for proton addition. An examination of the lowest rotational levels led to the conclusion that the numbers Z = 86 and N = 130 are to be associated with a sharp increase in deformation. The total effect of nuclear deformation is about 0.7 Mev for neutron and protons. The subshell effect is about 0.2 Mev except for N = 152 for which the effect is of the order of 0.4 Mev. (J.S.R.)

8688

INVERSE β PROCESSES AND NONCONSERVATION OF LEPTON CHARGE. B. Pontecorvo (Joint Inst. of Nuclear Research). Zhur. Eksptl'. i Teoret. Fiz. 34, 247-9(1958) Jan. (In Russian)

8689

THE ANGULAR DISTRIBUTION OF POSITRONS IN $\pi^+ - \mu^+ - e^+$ DECAY IN PROPANE. A. I. Alikhanyan, V. G. Kirillov-Ugryumov, L. P. Kotenko, E. P. Kuznetsov, and Yu. S. Popov (Lebedev Inst. of Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. 34, 253-4 (1958) Jan. (In Russian)

In consideration of the wide use of propane bubble cameras, investigations were made of the angular distribution of electrons from $\pi^+ - \mu^+ - e^+$ decay in propane to determine the possibility of using propane in angular correlation measurements of processes similar to $\mu - e$ decay. The scheme of the experiment made with a bubble chamber of $(7.2 \times 6.5 \times 16)cm^3$ dimensions bombarded by a 175-Mev π-meson beam from a phasotron is described. (R.V.J.)

8690

THE ANGULAR CORRELATION DEPENDENCE ON THE ENERGY IN $\mu^- - e^-$ DECAY. Yu. M. Ivanov and V. G. Kirillov-Ugryumov (Moscow Inst. of Industrial Physics). Zhur. Eksptl'. i Teoret. Fiz. 34, 255-6(1958) Jan. (In Russian)

Angular correlations for μ^- decay in 400 μ thick and 10 cm diameter emulsion were studied. The μ mesons arose from π^- meson decay at 350 Mev. 630 cases of $\mu - e$ decay were investigated where μ-meson tracks were not less than 50 μ from any point at the surface of the emulsion. In 135 cases of the $\mu - e$ decay 64 electrons scattered forward ($0 \leq \vartheta < 90°$) and 71 electrons scattered backward (at $90° < \vartheta \leq 180°$) which indicated that some μ mesons conserved their initial spin up to the point of their decay. The diagram of the energy spectra for the electrons emerging in forward and backward directions is shown. The relation of electron energy to the maximum $E_{max} = 50$ Mev plotted as abscissa and the number of electrons plotted as ordinate are included. The analysis of the $\mu^- - e$ decay angular correlation showed a good qualitative agreement with the theory of the two-component neutrino. (R.V.J.)

8691

ON THE INFLUENCE OF THE μ^--MESON POLARIZATION ON THE CORRELATION OF γ RAYS EMITTED BY MESO-ATOMS. V. A. Dzherbashyan (Inst. of Physics, Academy

of Armenian SSR). Zhur. Eksptl'. i Teoret. Fiz. 34, 260 (1958) Jan. (In Russian)

8692

NUCLEAR TECHNICS: PHYSICS, TECHNOLOGY, REACTORS. PART II. Wolfgang Riezler and Wilhelm Walcher, eds. Stuttgart, B. G. Teubner Verlagsgesellschaft, 1958. pp. 161-320.

Part II continues discussions of the special technological problems of nuclear techniques. The chemistry of radioactive substances, isotope separation, modification of materials by irradiation, treatment of radioactive wastes, and the use of radioactive and stable nuclides are considered. (J.S.R.)

Nuclear Properties

8693 INSJ-6

Tokyo. Univ. Inst. for Nuclear Study.

EVEN-EVEN NUCLEI. PART I. GENERAL SURVEY. PART II. NUCLEI OF SPIN SEQUENCE 0-2-2. Mitsuo Sakai. Feb. 24, 1958. 28p.

The systematics of the first and second excited states of even-even nuclei were worked out. Three distinct patterns of S(2), S(4) and C(4) were observed, correlating nicely with the grouping of nuclei in the Mayer-Jensen shell model. S(2) group (The spin sequence is 0-2-2 and E_2/E_1 is in general about 2) always occurs in the region of the neutron number where an energetically higher orbit of a large angular momentum competes with a spin $\frac{1}{2}$ orbit by reason of the large pairing energy. S(4) group (The spin sequence is 0-2-4 and E_2/E_1 is about 2) occurs generally in the region where the proton and neutron unfilled shell is just outside or inside of the closed shell. C(4) group (The spin sequence is 0-2-4 and E_2/E_1 is about 3) has at least the last proton or the last neutron in the unfilled shell lying above, at most, one filled shell outside of the closed shell. From this observation the characteristic neutron number of 90 and 136 might be understood. The efforts were focussed especially on the understanding of S(2) group, paying attention to the sign and the behavior of the mixing ratio, δ, of the upper transition. The nearer the neutron number approaches to the magic number, the more δ diminishes. The sign of δ alternates from one island to the other. (auth)

8694

REACTOR NEUTRON-CAPTURE CROSS SECTION OF 18-MINUTE Rb^{88}. J. C. Roy, P. J. Berry, and L. P. Roy (Atomic Energy of Canada, Ltd., Chalk River, Ont., Can.). Can J. Chem. 36, 731-6(1958) May.

The reactor neutron-capture cross section of 18-minute Rb^{88} has been determined by an activation method. The yield of Rb^{89} formed by successive neutron capture in Rb^{87} was determined by counting the beta rays emitted by its daughter, 51-day Sr^{89}. In these experiments Sr^{89} is also produced by the $Sr^{88}(n,\gamma)Sr^{89}$ reaction from the Sr^{88} contamination in the rubidium target and from Sr^{88} formed by the beta decay of Rb^{88}. Corrections for the contributions from these sources to the yield of Sr^{89} have been measured experimentally. The reactor neutron-capture cross section of Sr^{88} has been measured to be 5.8 mb. for the conditions of the experiment. Taking 0.12 ± 0.3 barn for the thermal cross section of Rb^{87}, the cross section of Rb^{88} was found to be 1.0 ± 0.3 barn for reactor neutrons. (auth)

8695

NUCLEAR COLLISION STOPPING OF ASTATINE ATOMS. R. B. Leachman and H. Atterling (Nobel Inst. of Physics, Stockholm). Arkiv Fysik 13, 101-8(1958).

The ranges and range stragglings of astatine atoms stopped in aluminum and in silver have been measured. The reactions $Au^{197}(C^{12},xn)At$ were used to provide astatine atoms with velocities near the Bohr velocity v_0, for which stopping is principally by nuclear collisions. The results are consistent with calculations involving an assumed potential of the screened field decreasing as r^{-2} from the nucleus for nuclear collisions. (auth)

8696

ON THE LOW LYING LEVELS OF Mn^{55}. Sadaaki Yanagawa (Univ. of Tokyo). J. Phys. Soc. Japan 13, 323-4(1958) Apr.

In this calculation of the low lying energy levels of Mn^{55}, the same treatment as in a previous note (Progr. Theoret. Phys. (Kyoto) 18, 661(1957)) is extended from the standpoint of the configurational mixings. One assumes that the potential between nucleons is $V(r_{12})[1 + a(\sigma_1 \cdot \sigma_2)]$: $V(r) = V_0 e^{-r^2/r_0^2}$, and the wave functions are the harmonic oscillator type. The factor λ is the ratio of the potential range r_0 to $1/\sqrt{\nu}$ which determines the extension of the wave function. The values of a and λ are determined from the experimental data of the energy splittings of the J = 0, 2 and 4 levels for Fe^{56}. And for these values of parameters, the competition of the low lying levels $J = \frac{1}{2}, \frac{5}{2}$ and $\frac{3}{2}$ for Mn^{55} is discussed. (auth)

8697

FISSION-PRODUCT YIELDS FROM U, Th and Pu. Seymour Katcoff (Brookhaven National Lab., Upton, N. Y.). Nucleonics 16, No. 4, 78-85(1958) Apr.

Graphs and tabulations of the fission yields of U^{235}, U^{233}, Pu^{239}, Th^{232}, and U^{238} and the decay chains and yields of U^{235} are given. (J.S.R.)

8698

PRECISION DETERMINATION OF SOME ENERGY LEVELS IN Fe^{57}, Zn^{67}, AND Tc^{99}. E. L. Chupp, J. W. M. DuMond, F. J. Gordon, R. C. Jopson, and Hans Mark (Univ. of California, Livermore). Phys. Rev. 109, 2036-40(1958) Mar. 15.

The 7.5-Mev deuteron beam of the A-48 linear accelerator has been used to produce strong sources of the radioactive nuclides Co^{57}, Ga^{67}, and Tc^{99} by means of the (d,n) and (d,p) reactions on Fe^{56}, Zn^{66}, and Mo^{98}. Co^{57} and Ga^{67} decay by K-capture to excited states at Fe^{57} and Zn^{67}. Tc^{99} is made by the reactions $Mo^{98}(d,n)Tc^{99}$ and $Mo^{98}(d,p)Mo^{99}$ in which Mo^{99} subsequently decays to Tc^{99} with a half-life of 67 hours. Appropriate sources containing these nuclides were exposed in the high-resolution bent quartz crystal spectrograph previously described and photographic spectra were obtained of the strongest nuclear gamma rays emitted by these sources. The plates were calibrated with x rays and gamma rays of known wavelengths. The energies (in kev) of the various gamma rays measured are: Fe^{57}, 122.05 ± 0.05 and 136.40 ± 0.06; Zn^{67}, 93.26 ± 0.04 and 184.46 ± 0.27; and Tc^{99}, 140.52 ± 0.16. The cascade gamma ray between the two levels in Zn^{67} was also observed and its energy was determined as 91.22 ± 0.04 kev in good agreement with the difference (91.20 ± 0.27 kev) between the values quoted above for this isotope. (auth)

8699

STRENGTH FUNCTION DETERMINATIONS USING FAST NEUTRONS. F. Boreli and S. E. Darden (Univ. of Wisconsin, Madison). Phys. Rev. 109, 2079-82(1958) Mar. 15.

Using the $Li^7(p,n)Be^7$ reaction as a source of neutrons, strength function determinations have been made on a number of intermediate and heavy elements at average neutron energies between 65 kev and 360 kev. The strength functions $(\gamma_1^2)_{Av}/D$ are obtained from measurements of the deviation from exponential attenuation of the neutrons passing through a sample of the element being studied. Values of $(\gamma_0^2)_{Av}/D$ at lower energies exhibit qualitatively the de-

pendence on atomic weight predicted by the optical model, in agreement with previous measurements. For elements in the region A = 90, the rapid increase with energy of the $(\gamma_0^2)_{Av}/\overline{D}$ obtained assuming only S-wave interactions suggests appreciable P-wave interactions are taking place. The data for these elements have been analyzed to yield $(\gamma_1^2)_{Av}/\overline{D}$. (auth)

8700

PROTON STRENGTH FUNCTIONS FROM (p,n) REACTION CROSS SECTIONS. J. P. Schiffer and L. L. Lee, Jr. (Argonne National Lab., Lemont, Ill.). Phys. Rev. 109, 2098-2104(1958) Mar. 15.

The (p,n) reaction cross section has been measured for thick targets of thirty-one elements ranging in atomic weight from 37 to 133 with incident proton energies between 2.0 and 4.0 Mev. The reaction yields were divided by a penetrability factor to yield a "reduced cross section" closely related to the proton strength function. Peaks in the reduced cross section were observed at atomic weight 50 and 68. These were tentatively identified as the peaks in the D-wave and S-wave strength functions of the complex-potential model corresponding to effects observed in neutron experiments at atomic weights 40 and 51. Assuming these identifications, the difference between proton and neutron potentials was calculated. Within the validity of the assumptions. Vr_0^2 for nuclei in the vicinity of atomic weight 70, was found after Coulomb corrections to be 6 ± 6% larger for protons than for neutrons. The reduced cross section was observed to double in going from atomic weight 37 to 133. possibly because of the effect of spheroidal deformation on the barrier penetrability. Angular distribution measurements showed symmetry about 90° to better than 5%, indicating no measurable direct-interaction component in the reaction. The largest anisotropies observed were approximately 20%. (auth)

8701

NUCLEAR STRUCTURE EFFECTS IN INTERNAL CONVERSION. T. A. Green (Wesleyan Univ., Middletown, Conn.) and M. E. Rose (Oak Ridge National Lab., Tenn.). Phys. Rev. 110, 105-22(1958) Apr. 1.

The problem of the influence of nuclear structure on the calculation of conversion coefficients is discussed and a distinction is made between those effects (static) which are essentially calculable without a detailed nuclear model and the effects (dynamic) for which such a model is mandatory. The theory of the conversion process is developed in such a way as to provide formulas wherein both types of effects are exhibited. No attempt is made to provide specific numerical results for the dynamic effects but instead a framework is provided within which the internal conversion predictions of any nuclear model can be readily tested. In order to do this it is necessary to know not merely the conversion coefficient but the matrix elements for the separate final states as complex numbers. This information, which is available at present for only the K shell, is utilized to provide numerical results for the K shell and for several values of transition energy and atomic number. Electric and magnetic 2^L-pole transitions with $1 \leq L \leq 5$ are considered. (auth)

8702

LIFETIMES OF THE 4.43-Mev EXCITED STATE OF C^{12} AND THE 4.46-Mev EXCITED STATE OF B^{11}. V. K. Rasmussen, F. R. Metzger, and C. P. Swann (Franklin Inst., Swarthmore, Penna.). Phys. Rev. 110, 154-60(1958) Apr. 1.

Doppler-broadened 4.43-Mev γ radiation from the reaction $N^{15}(p,\alpha)C^{12*}$ has been used to measure the lifetimes of the 4.43-Mev level of C^{12} and the 4.46-Mev level of B^{11} by the nuclear resonance fluorescence technique. For C^{12}, the 90° and 126° scattering give mean lives of $(6.7^{+1.5}_{-0.4}) \times 10^{-14}$ sec and $(5.5^{+1.2}_{-0.4}) \times 10^{-14}$ sec, respectively. The self-absorption of the resonance radiation gives $(6.6 \pm 1.3) \times 10^{-14}$ sec. The adopted mean value is $(6.5 \pm 1.2) \times 10^{-14}$ sec. For B^{11}, the angular distribution of the resonance-scattered radiation is $1 + (0.1 \pm 0.1)P_2(\cos\theta)$, and the cross section corresponds to $\tau = (1.02^{+0.23}_{-0.07}) \times 10^{-15}$ sec if the spin of the excited states is $\frac{5}{2}$. Interpretation of the self-absorption of the resonance radiation is uncertain because of the lack of information as to the Debye temperature of B_4C. Values of 1250°K and 1860°K give $\tau = 1.33 \times 10^{-15}$ sec and $\tau = 1.14 \times 10^{-15}$ sec. The adopted mean value is $\tau = (1.17 \pm 0.17) \times 10^{-15}$ sec. (auth)

8703

A REMARK ON THE MOMENTS OF INERTIA OF ROTATING NUCLEI. Satio Hayakawa and Toshio Marumori (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 18, 396-404 (1957) Oct.

The quantum mechanical description of a two dimensional rotating system of particles is studied to elucidate the meaning of the effective moments of inertia of nuclei. The method of canonical transformations is employed. The rotational kinetic energy of a "canonical form" is obtained by introducing an internal angular momentum L_{in}. The Coriolis force arising from the coupling of L_{in} with the rotational angular velocity is found to be responsible for the deviation of the moment of inertia from its hydrodynamical value. The explicit form of L_{in} is given as a function of the positions and momenta of individual particles. This form of L_{in} should be used for deriving the effective moment of inertia. Comparison with the cranking model of Inglis is discussed. (auth)

8704

MEASUREMENTS WITH A SLOWING-DOWN-TIME NEUTRON SPECTROMETER EMPLOYING LEAD. EXCITED LEVEL OF THE He^4 NUCLEUS. A. A. Bergman, A. I. Isakov, Iu. P. Popov, and F. L. Shapiro (P. N. Lebedev Physics Institute, Academy of Sciences, USSR). Soviet Phys. JETP. 6, 6-11(1958) Jan.

Results of measurement of the energy dependence of the cross sections are presented for the following reactions: (n,γ) in Fe, Pb, and Cl; (n,p) in He^3, N^{14}, and Cl; and (n,α) in Li^6 and B^{10}. Neutron energies up to 30 kev were employed. It is shown that the cross section for the $B^{10}(n,\alpha)$ reaction lies below the 1/v law, the deviation being smaller than 5 to 10%. The deviation of the $Li^6(n,\alpha)$ cross section from the 1/v law is even less. It is concluded that the B^{11} nucleus has an excited level with an angular momentum $J = 5/2^+$ or $7/2^+$, a neutron resonance energy $E_r \sim 250$ kev, and widths $\Gamma_\alpha \sim 400$ and $\Gamma_n \sim 200$ kev. An appreciable deviation of the $He^3(n,p)$ cross section from the 1/v law has been detected which may indicate the existence in the He^4 nucleus of an excited level with one of the two sets of parameters: 1) $J = 1^+$, $-E_r \sim 200$ kev, proton width for an excitation energy equal to the neutron binding energy $\Gamma_{p^0} \sim 200$ kev and 2) $J = 0^+$, $-E_r \sim 500$ kev, $\Gamma_{p^0} \sim 1200$ kev. (auth)

8705

PHOTODISINTEGRATION OF HELIUM. I. A. N. Gorbunov and V. M. Spiridonov (P. N. Lebedev Physics Inst., Academy of Sciences, USSR). Soviet Phys. JETP. 6, 16-25 (1958) Jan.

The photodisintegration of helium was studied with a cloud chamber located in a magnetic field and synchronized with a 170 Mev bremsstrahlung beam. The yields of the different photonuclear reactions on helium were determined. The energy dependence of the cross section and the angular distributions of the protons and the tritons were measured for the reaction $He^4(\gamma,p)H^3$. The results are

compared with data obtained in other investigations and with theoretical predictions. (auth)

8706

NEW FORM OF ISOMERISM IN Eu^{152}. L. K. Peker (Library of the Academy of Sciences, USSR). Soviet Phys. JETP: 6, 226-8 (1958) Jan.

The experimental values of 3- and 1- for the spins of the ground state (T = 13 years) and isomeric state (T = 9.2 hr) of Eu^{152} lead to several difficulties. The spin difference between the states indicates that the gamma transition between the two is E2, but this transition is never observed. The singly forbidden beta decay of 13-year Eu^{152} to the first and second 2- levels of Gd^{152} has a log*f* value of 12, much slower than ordinary transitions by a factor of about 10^5. Comparisons of the probabilities for beta and K transitions of the same type, as well as the values for the total ratios K/β^- for the ground state plus the isomeric state show that 9.2-hr Eu^{152} decays primarily to Gd^{152} levels, and that 13-year Eu^{152} decays to Sm^{152} levels. The hypothesis is advanced that these singularities can be explained by the assumption that the 13-year Eu^{152} has an ellipsoidal equilibrium shape and the 9.2-hr Eu^{152} has a spherical equilibrium shape. This hypothesis is also supported by data on the spin and magnetic moment of 13-year Eu^{152}. (J.S.R.)

8707

ON THE ANGULAR ANISOTROPY OF FRAGMENTS ESCAPING IN Pu^{239} FISSION BY 14 Mev NEUTRONS. A. N. Protopopov and V. P. Eismont (Radium Inst. Acad. of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. 34, 250-1 (1958) Jan. (In Russian)

The degree of anisotropy in Pu^{239} fission with a small spin $I = \frac{1}{2}$ and resulting in even-even parity nuclei after neutron capture has been determined. (R.V.J.)

Nuclear Reactors

Refer also to abstract 8387.

8708 AECL-557

Atomic Energy of Canada Ltd., Chalk River, Ont.

THE CANADIAN STUDY FOR A FULL-SCALE NUCLEAR POWER PLANT. Jan. 1958. 64p. $1.50(AECL).

The possible demand for nuclear power in Canada and the cost factors and development problems of power reactor are discussed. The proposed reactor has a thermal power of 794 Mw and a net electrical output of 200 Mw. It uses slugs of natural uranium oxide as fuel and is cooled and moderated by heavy water. The fuel is housed in horizontal pressure tubes through which the pressurized heavy-water coolant passes. There are 200 to 250 tubes mounted on a square lattice with a pitch of 12 in. (30.5 centimeters). There is thermal insulation associated with each pressure tube so that the moderator can be kept relatively cool. This has an advantage in increasing the reactivity of a given configuration as a cool moderator is more efficient at slowing down neutrons. Oxide was chosen as fuel as it has incomparably better dimensional stability than uranium metal and, in the event of a rupture of its sheathing, would not react chemically with hot water. The fuel sheaths and the pressure tubes would probably be of Zircaloy-2 unless an aluminum alloy satisfactory for use with hot water were developed in time. The fuel is in the form of slugs which are to be fed in opposite directions in adjacent channels (bi-directional fuelling) and with the changes being made while the reactor is operating. An outstanding feature of the design is the high burn-up planned for the unenriched oxide, viz. 8100 Mwd/t of contained uranium. This is the limit set by fission-product poison in the chosen design; it is achieved by stressing conservation of reactivity to the extent shown to be economically desirable (heavy-water moderator, bi-directional slug fuelling, choice of structural materials to reduce neutron absorption and good reflection). Taking the burn-up to this 8100 Mwd/t is considered to be of greater economic advantage than improving the steam conditions and the somewhat poor thermal efficiency of the plant. If suitable materials of construction were available so that temperatures could be raised and steam conditions improved, the higher pressures would demand thicker pressure tubes; these in turn lead to greater neutron absorption and a consequent reduction in the allowable burn-up for the fuel. The cost analyses show that more can be gained by increasing the burn-up even at some sacrifice in thermal efficiency. The major features of the proposed reactor are described and a brief indication is given of the reasons affecting each choice. A summary of the important data regarding the plant is given in an appendix. (auth)

8709 AECU-3678

Atomic Power Development Associates, Inc., Detroit.

REPORT ON CORE AND BLANKET DESIGN AND TECHNOLOGY. C. M. Ladd, R. J. Hennig, O. E. Homeister, D. O. Leeser, R. A. MacLeod, R. G. Rateick, and L. P. VanMaele. Jan. 1, 1958. 45p. $7.80(ph OTS); $3.30 (mf OTS).

A summary is presented of the information developed to date on the core and blanket fuel materials for the Fermi Fast Breeder Reactor. The specification requirements for the core and blanket subassembly fabrication are discussed, along with special materials accountability and shipping problems. (W.L.H.)

8710 AERE-T/R-1692

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

NEUTRON DIFFUSION IN REACTORS WITH LARGE HOLES. A. Hassitt. Aug. 1955. Decl. Mar. 18, 1958. 22p.

In a reactor containing a cavity, the neutrons diffuse in the material, but stream in straight lines across the hole. The conditions on the boundary of the hole are not easy to deal with. The flux at any point depends on the flux at every other point on the surface of the hole. An iterative method of satisfying these boundary conditions, in the spherical harmonics P_1 approximation, is examined. The iteration is started by taking the flux to be constant on the surface of the hole. The diffusion equations are solved numerically, and a new value of the flux at each point is calculated, by computing the number of neutrons streaming across from all other points on the surface of the hole. The diffusion equations are solved again, with the new values of the flux on the hole surface, and the whole process is repeated. The necessary, but not sufficient, condition "no neutrons created or absorbed in the hole" is satisfied at each stage of the iteration. A simple example of a bare cylindrical reactor, with an enclosed cylindrical cavity, is considered. The iterative process appears to converge after three iterations. Applications of the method to more elaborate systems are being considered, and the conditions for the validity of the P_1 approximation are being examined. (auth)

8711 ANL-5721

Argonne National Lab., Lemont, Ill.

BORAX-IV REACTOR: MANUFACTURE OF FUEL AND BLANKET ELEMENTS. Work Completed: November 1956. D. K. Walker, R. A. Noland, F. D. McCusig, and C. C. Stone. Mar. 1958. 75p. Contract W-31-109-eng-38. $2.00(OTS).

The procedures used in fabricating the core loading for

the natural water-cooled Borax-IV reactor are described. Manufacturing of the fuel plates and blanket plates, which contain fissile (U^{235}) and/or fertile (Th^{232}) material in ceramic form, lead-bonded within tubes in aluminum-1 wt. % nickel extrusions, is described in detail. A brief description of the assembly and welding of the finished plates into subassemblies and assemblies is given. Preparation of the ceramic bodies was described by others in ANL-5669 and ANL-5678. (auth)

8712 ANL-5799
Argonne National Lab., Lemont, Ill.
DYNAMIC ANALYSIS OF NATURAL CIRCULATION BOILING WATER POWER REACTORS. Eric S. Beckjord. Mar. 1958. 30p. Contract W-31-109-eng-38. $1.00(OTS).

Linear Feedback Control Theory is used to analyze the small-signal dynamic behavior of direct cycle, natural circulation boiling water reactor systems. Transfer functions for thermodynamic and hydraulic effects are derived in terms of reactor core and vessel dimensions. They are used to construct a theoretical system block diagram for the EBWR. (auth)

8713 ANL-5836
Argonne National Lab., Lemont, Ill.
EBR-I, MARK III–DESIGN REPORT. R. E. Rice, R. N. Curran, F. D. McGinnis, M. Nevick, and F. W. Thalgett. Mar. 1958. 42p. Contract W-31-109-eng-38. $1.25(OTS).

Under severe operating conditions, the Experimental Breeder Reactor was observed to exhibit oscillatory power characteristics and periods of prompt positive reactivity. Investigations of these characteristics resulted in the meltdown of Core-II and the design of a more suitable Core-III, with rod bowing eliminated and greater coolant flow control. The design of the core, rods, assemblies, and matrices is presented, and its control and cooling systems are described. (D.E.B.)

8714 APEX-362
General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.
REACTOR CELL CALCULATIONS FOR SOME CYLINDRICALLY SYMMETRIC FUEL ELEMENTS SURROUNDED BY MODERATOR. J. A. McLennan. Aug. 15, 1955. 59p. Contracts AF33(038)-21102 and AT(11-1)-171. $1.75(OTS).

Calculations of flux and transmission factors for cells consisting of a fuel element surrounded by moderator are presented. Three fuel element configurations are considered: the homogeneous fuel cylinder, the homogeneous fuel cylinder in the center of a void annulus, and the cylindrical shell of fuel in the center of a void annulus. The calculations for the three geometries are carried out for both cosine and cosine squared neutron angular entrance distributions. (auth)

8715 CEND-0005-RS-17
Combustion Engineering, Inc., Nuclear Div., Windsor, Conn.
SUMMARY OF PROGRESS IN UNCLASSIFIED AREAS OF REACTOR TECHNOLOGY. Feb. 6, 1958. 19p. $4.80 (ph OTS); $2.70(mf OTS).

Calculations for the resonance fission and capture integrals for U^{235} infinitely diluted are presented, along with stochastic methods for estimating integral transport equations and solving one-dimensional monoenergetic transport equations. Low-cobalt stainless steels are compared with other likely metals for use in reactor core baskets and thermal shields. An analysis of the theoretical and experimental work on stringer corrosion in Zircaloy is presented. (For preceding period see CERD-005-RS-9.) (J.R.D.)

8716 CF-57-2-24
Oak Ridge National Lab., Tenn.
BELLOWS FAILURE IN SOLIDS SEPARATION LOOP OF THE HRT MOCKUP. T. M. Kegley, Jr., and J. P. Hammond. Feb. 5, 1957. 9p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

The failure of the valve bellows would appear to be due to a combination of stress corrosion and crevice corrosion. Stress corrosion occurred as evidenced by the transgranular branched cracking found in the bellows and in the base which was joined to the bellows. It seems probable that chlorides were present, which, along with the residual stresses present in the bellows assembly, created the necessary conditions for stress corrosion to occur. Crevice corrosion occurred probably due to heavy deposits of solids at the base of the bellows, which created a condition of oxygen impoverishment. While the crater in the base may have been related to a galvanic effect created by the gold gasket, the contour of the crater would suggest that the cause of the crater was due more to crevice corrosion. (auth)

8717 CF-57-8-5
Oak Ridge School of Reactor Technology, Tenn.
DESIGN STUDY OF AN ADVANCED TEST REACTOR. Reactor Design and Feasibility Study. W. L. Carter, C. D. Cagle, C. W. Garrett, F. E. Hankins, E. L. Humez, W. L. Kirk, C. L. Morrison, D. J. Niehaus, and R. E. Woodard. Aug. 1957. 208p.

A conceptual design of an advanced engineering test reactor is presented. The reactor is a heavily-loaded, fully-enriched U^{235} system containing four 8-in. diameter experiment tubes penetrating the core. The core configuration is two fuel slabs separated by a D_2O moderating region containing the four experiment tubes. A fast neutron reflector of 70 volume % aluminum and 30 volume % D_2O comprises the region at the outside of the fuel slabs. Unperturbed thermal neutron fluxes as high as 2.48×10^{15} neutrons/cm^2-sec can be supplied to the experiment region for a core lifetime of greater than 12 days at a total reactor power not exceeding 500 Mw. (auth)

8718 CF-58-2-46
Oak Ridge National Lab., Tenn.
A MOLTEN SALT NATURAL CONVECTION REACTOR SYSTEM. F. E. Romie and B. W. Kinyon. Feb. 5, 1958. 27p. Contract [W-7405-eng-26]. $4.80(ph OTS); $2.70 (mf OTS).

Fuel-salt volumes external to the core of a molten-salt reactor are calculated for a system in which the fuel salt circulates through the core and primary exchanger by free convection. In the calculation of these volumes, the exchanger heights above the core top range from 5 to 20 ft. Coolants considered for the primary exchanger are a second molten salt and helium. External fuel holdup is found to be the same with either coolant. Two sets of terminal temperatures are selected for the helium. The first combination permits steam generation at 850 psia, 900°F. The second set is selected for a closed gas turbine cycle with an 1100°F turbine inlet temperature. Specific power (thermal kw/kg 235) is found to be about 900 kw/kg, based on initial, clean conditions and a 60 Mw (thermal) output. A specific power of 1275 kw/kg is estimated for a forced convection system of the same rating. (auth)

8719 CF-58-3-68
Oak Ridge National Lab., Tenn.
HOMOGENEOUS HIGH-FLUX REACTOR. W. K. Ergen. Mar. 31, 1958. 5p. Contract [W-7405-eng-26]. $1.80 (ph OTS); $1.80(mf OTS).

Maximum thermal-neutron fluxes obtainable for the case

that maximum power density is limited to 100 w/cm^3, and for the case that total reactor power is 100 Mw are listed for a homogeneous reactor, and for five moderators. (auth)

8720 CF-58-4-66
Oak Ridge National Lab., Tenn.
SOME NUCLEAR CHARACTERISTICS OF SPHERICAL DOUBLE-BLANKET REACTORS. Melvin Tobias and T. B. Fowler. Apr. 18, 1958. 16p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

A number of cases were studied to determine some of the nuclear characteristics of double-blanket reactors. The reactor geometry is spherical, the average temperature is 280°C, the core ID is 4 ft and the pressure vessel ID is 9 ft in all cases. The core is contained in a ½-in. Zircaloy tank, while the blanket is divided into two regions by another another ½-in. Zircaloy shell. The region adjacent to the core is either 0.5 or 1-ft thick. Comparison is made of reactors in which either the inner or outer blanket region contains 4000 g Th/liter as ThO_2 slurry in D_2O while the other blanket region holds thorium concentrations of 0, 500, or 1000 g Th/liter. The effects of introducing an 8% poison fraction into the core and 3 g U^{233}/kg Th into the blanket are examined individually. It is found that reactivity effects are negligible if the inner blanket contains 4000 g Th/liter and settling occurs in the dilute outer region. On the other hand, for a concentrated outer blanket, large reactivity additions are to be expected on removing the thorium from the dilute inner region. Some fuel and thorium inventory reductions appear possible if a concentrated inner blanket is used. Information has also been obtained concerning power distributions and core-wall thermal flux. (auth)

8721 CF-58-4-108
Oak Ridge National Lab., Tenn.
COMPARISON OF GASES FOR USE AS THE COOLANT IN A GAS-COOLED REACTOR. G. Samuels. Apr. 28, 1958. 12p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40 (mf OTS).

The expression $[M(Pr)^{⅔}/(M\ C_p)^3]$ which is often used to compare the merits of various gas coolants is derived and the errors involved in using this term are discussed. An example using CO_2 and He is shown to illustrate the difference between the true pumping power required and that predicted by the above expression. (auth)

8722 CRCE-695
Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.
CONTRIBUTION TO POWER COST BY SHEATHING MATERIALS. J. Y. Glass. Dec. 1957. 26p. (AECL-547). $1.00(AECL)

The contribution to power cost by three fuel sheathing materials, aluminum-nickel alloy, Zircaloy-2, and stainless steel, was estimated. Uranium oxide, in pellet form, was considered as the fuel material. Since aluminum-nickel alloys are not as corrosion resistant to high temperature water as is Zircaloy-2, a method is presented to determine the corrosion resistance such alloys would have to have to compete economically with the Zircaloy-2 as sheathing materials. The results of this study show that if Zircaloy-2 sheathing material can be purchased for a price of $50 per pound of tubing, then Al-Ni alloy sheathing should have a corrosion resistance life of at least 630 days in the reactor (average power density—12.8 Mw/t of UO_2) to compete economically with the Zircaloy-2. (auth)

8723 DL-33 (Rpt: UNCLASSIFIED)
Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.
URANIUM OXIDE FUEL OF LOW COST. W. B. Lewis. Apr. 1958. 18p. (AECL-568). $0.50(AECL).

In the United States and Canada it seems reasonable to set the dividing line between high and low cost fuel at 1.5 mill/kwh. To achieve this as the total fuelling cost including both supply and charges on the inventory of fabricated fuel requires careful planning. Dense sintered UO_2 is promising because it withstands high burn-up such as 10,000 Mwd/t without swelling and it retains fission product gases fairly well. It is also chemically stable in water at high temperature but it is a bad conductor of heat, and is liable to crack under thermal shock. This cracking has not been found troublesome in round rods clad in a firm sheath. The poor thermal conductivity, however, limits the diameter of such round rods if the central temperature is to be kept well below the melting point. Recent experiments have shown, nevertheless, that rod diameters of 0.6 to 0.9 in. may be practicable, even for large power reactors. In such large sizes the costs of fabricating sintered pellets and of cladding even in costly Zircaloy need not be prohibitive. Experience even on a small scale of hundreds or a few thousand pounds of oxide has resulted in total costs of little over $30 per lb of UO_2. Moreover for large power (200 Mwe) reactors taking advantage of heavy water as moderator and coolant it is possible to achieve a burn-up yield of 8,000 Mwd/t of uranium and a total fuelling cost of 1.5 mill/kwh if the fuel costs $26/lb of UO_2. Even with Zircaloy cladding this seems within reach and in a few years with fabrication on a larger scale $20/lb of UO_2 is in prospect. Experiments are in progress on the retention of fission product gases and if these sustain the present promise it will be possible to adopt simpler and cheaper techniques of fuel cladding. Moreover recent results with aluminum-nickel alloys suggest that these might replace the more costly Zircaloy, but an example is given showing that this may not reduce the over-all fuelling costs. Adjusting the reactor design to minimize total costs may increase the power rating and raise the fuel costs, but at the same time fuel burn-up may be extended and with the cheaper fuel in prospect the total fuelling costs may be held at about 1.0 mill/kwh from natural uranium oxide without any reprocessing. (auth)

8724 HW-55590 A2
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PLUTONIUM RECYCLE PROGRAM MONTHLY REPORT [FOR] MARCH 1958. F. W. Albaugh, L. P. Bupp, and P. F. Gast. Apr. 15, 1958. 18p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

Progress is reported briefly in development of fuel element materials, instrumentation, and mechanical equipment for the PRPR. (For preceding period see HW-55162 A2.) (W.L.H.)

8725 IDO-16378
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
PLUTONIUM FUEL REQUIREMENTS FOR OPERATION OF THE MTR. H. L. McMurry and B. W. Johnson. June 11, 1957. 31p. Contract AT(10-1)-205. $6.30(ph OTS); $3.00(mf OTS).

An approximate equation for the fuel content of Pu^{239} per assembly needed to give the same charge life as a stated content of U^{235} is derived by a perturbation method. Current MTR practice requires refueling after 400 Mwd operation. About 180 grams of U^{235} per fuel assembly are required. On this basis about 125 grams of Pu^{239} per assembly are predicted. The initial critical position for the Pu^{239} fueled reactor is estimated to occur when the shim rods are in 1.5 inches deeper than in the U^{235} system. This will aggravate the hot spot problems. The equations used here are derived using a number of approximations. It is believed that the predicted Pu^{239} fuel content is fairly good,

but the estimate of the initial shim rod level relative to the U^{235} fueled reactor is only qualitative. Certainly at start-up the shims will be more deeply inserted in the Pu^{239} system. (auth)

8726 IDO-16405

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

PILE PRODUCTION OF PLUTONIUM-240 FROM PLUTONIUM-239 IRRADIATED UNDER TIME VARIABLE FLUX CONDITIONS. R. J. Howerton. Aug. 23, 1957. 29p. Contract AT(10-1)-205. $1.00(OTS).

Equations are derived for the formation of a daughter isotope from a parent isotope under constant power operation of a thermal reactor. An example is worked out for the formation of plutonium-240 from plutonium-239. (auth)

8727 IDO-16414

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

HEAT GENERATION WITHIN THE THERMAL SHIELDS AND VESSEL WALL OF THE SPERT-III REACTOR. V. C. Kobold. Mar. 1, 1958. 22p. Contract AT(10-1)-205. $0.75(OTS).

Calculations of heat generation within the thermal shields and the vessel wall of the SPERT-III Reactor are presented. The calculations were performed to check an earlier estimate and assure adequacy of the shield design prior to installation in the reactor. The data are derived from an evaluation of the heat generated by the adsorption of gamma photons from fission and from neutron capture within the core, reflector and shield regions. The results predict that there will be no excessive thermal stresses within the shields and the vessel shell and that, therefore, the present SPERT-III thermal shield configuration is an adequate design. (auth)

8728 IDO-16434

Ramo-Wooldridge Corp., Los Angeles.

THEORY OF POWER TRANSIENTS IN THE SPERT I REACTOR. PART I. EXACT SOLUTION OF THE PILE KINETIC EQUATIONS. H. C. Corben. PART II. A MODEL FOR TRANSIENTS IN THE SPERT I REACTOR. W. A. Horning. PART III. THEORY OF SMALL OSCILLATIONS OF THE SPERT REACTOR. H. C. Corben. PART IV. SPHERICAL BUBBLE GROWTH. G. Birkhoff, R. S. Margulies, and W. A. Horning. Jan. 10, 1958. 64p. For Phillips Petroleum Co. Atomic Energy Div. Contract AT(10-1)-205, Subcontract C-202. $10.80(ph OTS); $3.90(mf OTS).

Part I. The space-independent pile kinetic equations are solved to give the excess reactivity explicitly in terms of the pile power and its history. The solution is applicable to arbitrary variations of power with time and is examined in detail for the case of small damped oscillations about a slowly varying average power and for a power fluctuation occurring during a short time interval. The reactivity compensated during a power surge is computed as a function of the period by fitting the observed power to a simple algebraic expression. Part II. A model of power transients and resonance instability in SPERT I is presented. The model assumes thermal expansion and void growth as the mechanisms for power-induced reactivity change. The model accounts for the observed features of the initial power peak in a general way. It is more successful, even semi-quantitative, as a description of resonance instability as observed in SPERT I. Part III. The phenomenological treatment of void formation in the SPERT reactor, is combined with the pile kinetic equations, and the resulting system of equations is studied for small oscillations about an average power level ϕ_0. The frequency is shown to be approximately proportional to $\phi_0^{1/2}$, in reasonable agreement with experiment. Damping is predicted to occur below a certain critical power level the value of which depends, among other quantities, on the rate at which voids formed in the water inhibit the production of further voids. Part IV. Plesset and Zwick have calculated the rate of growth of vapor bubbles in slightly superheated steam under constant external pressure. Their calculation assumes that the temperature drop is localized in a thin "boundary layer" near the bubble wall; the predicted bubble radius R(t) is asymptotically proportional to $t^{1/2}$ when R is large enough for surface tension to be negligible. An analysis of this asymptotic phase is given which avoids the above "boundary layer" assumption. The analysis is shown to be (approximately) applicable also to gas bubbles in supersaturated liquids. (auth)

8729 ISC-839

Ames Lab., Ames, Iowa.

THERMAL STRESS ANALYSIS OF A CYLINDER OF SEMI-PLASTIC MATERIAL. Donald Hunter and Glenn Murphy. Dec. 1956. 35p. Contract W-7405-eng-82. $1.00(OTS).

A solution is derived for the thermal stresses in a finite cylindrical solid composed of a material for which the modulus of elasticity decreases linearly with an increase in temperature. The cylinder is assumed to contain a distributed heat source that is radially symmetrical. The solution is applied to evaluate the stresses in a cylindrical uranium fuel slug in which heat is produced by fission. The results are compared with those obtained from a plane strain solution. (auth)

8730 KAPL-1842

Knolls Atomic Power Lab., Schenectady, N. Y.

ANALYSIS OF REACTOR POWER COEFFICIENTS BY MACHINE METHODS. L. G. Barrett and E. D. Reilly, Jr. Aug. 1957. 19p. Contract W-31-109-eng-52. $0.75(OTS).

The IBM-704 machine code, JUGGLER, has been developed for the purpose of performing an analysis of the over all power coefficient data obtained by pile oscillator measurements. When the over-all coefficient can be expressed in an analytical form satisfying the limitations of the code, the analysis will produce best values for the individual zero frequency power coefficients and their respective effective thermal time constants. Since the calculation involves an iterative technique, first guesses must be obtained from the unknown parameters. For illustrative purposes a hypothetical reactor was used and the response calculated for a fictitious set of pile oscillator measurements. Methods are outlined then for obtaining first guesses from the resultant "measured" over-all power coefficient. The JUGGLER code was then employed and the resultant calculated parameters compared with the original assigned values. (auth)

8731 KAPL-M-JHP-6

Knolls Atomic Power Lab., Schenectady, N. Y.

AN APPROXIMATE METHOD FOR CALCULATING REACTOR TEMPERATURES DURING COMPLETE LOSS OF FLOW ACCIDENTS. Jack H. Pigott. July 18, 1957. Decl. Feb. 18, 1958. 18p. Contract [W-31-109-Eng-52]. $4.80(ph OTS); $2.70(mf OTS).

A simple approximate method of calculating reactor temperatures during loss of flow accidents based on the equivalent thermal wave velocity approximation is described. The method is developed in detail for single pass cores or two pass cores in which the highest temperatures during the accident occur in the first pass or in which the delay time between passes is sufficiently long so that the second pass does not experience a change in inlet temperature before the accident is terminated by scram. However the method may be extended to cases where neither of these assumptions is true. The power reduction due to tempera-

ture effect is taken into account. Flow redistribution is not considered and thus the analysis is limited to cases where appreciable bulk boiling does not occur. (auth)

8732 KAPL-M-TMS-6(Del.)
Knolls Atomic Power Lab., Schenectady, N. Y.
DILUTION REQUIREMENT FOR HOMOGENEOUS REACTORS. T. M. Snyder. Mar. 4, 1952. Decl. with deletions Feb. 22, 1957. 6p. Contract W-31-109-eng-52. $1.80 (ph OTS); $1.80(mf OTS).

It is shown that the field of application of homogeneous reactors is limited by the requirement of large fuel dilution to either power reactors where neutron economy is not an important objective, or converters and breeders using a thermal spectrum. In the second application the diluting fluid must have an extremely small capture cross section. The choice of diluents for these two applications is discussed. (M.H.R.)

8733 KLX-1769; KLX-1769A
Vitro Corp. of America. Vitro Engineering Div., New York.
CONCEPTUAL DESIGN OF 20 Mw NUCLEAR HEATING PLANT. Vitro Job No. 1186. G. Caravella, R. Epstein, L. Geller, S. Hellman, M. Naparstek, and F. Shafran. Nov. 1, 1956. Decl. Oct. 1, 1957. 199p. Addendum and Errata. Jan. 1, 1957. 11p. Contract DA-44-009-Eng-2861.

These two reports were issued separately, but are cataloged as a unit.

A conceptual design was prepared describing a nuclear heating plant to produce 20 Mw of reactor heat for use, through a heat exchanger, in a space heating system. The fuel plates consist of highly enriched (93%) UO_2 embedded in stainless steel and clad with stainless steel. Purified light water, pressurized to 750 psia, is used as the moderator and coolant. The reactor, when loaded with 33.61 kg of U^{235}, provides 20 Mw yr of power before refueling. In order to reduce the reactivity excursion and facilitate control a burnable poison, in the form of boron, is incorporated in the fuel elements. The estimated capital investment, not including the uranium, is $1,942,310. The cost of operation per year is $967,400 or 5.5 mils/kw hr_h. (auth)

8734 NAA-SR-2400(Pt. I)
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.
ANNUAL TECHNICAL REPORT, AEC UNCLASSIFIED PROGRAMS, JANUARY–DECEMBER 1957. PART I. Mar. 15, 1958. 184p. Contract AT-11-1-GEN-8. $7.25 (OTS).

Operations experience from the Sodium Reactor Experiment is reviewed with special emphasis given to unexpected performance characteristics of the reactor and component behavior which limits sodium graphite reactor efficiency. Development programs initiated as a result of this experience include methods for coolant flow control following scram, improved moderator canning techniques, better moderator can materials, and higher-performance fuel alloys. Additional work is reported on large sodium graphite reactor design. Preliminary design studies for the Hallam Power Reactor are included. A general description is given of the procedures involved in cleaning, fuel and coolant loading, startup, and initial testing of the Organic Moderated Reactor Experiment. Additional data from inpile studies of the chemical and physical properties of biphenyl and polyphenyls are presented. Preliminary design studies of large organic moderated power reactors are included. Additional experimental studies were made of the dynamic behavior of homogeneous, water-moderated reactors to evaluate their inherent shutdown characteristics. Results are included from studies of radiolytic gas production rates, temperature coefficients of reactivity, void coefficients of reactivity excursions. Equations were developed for describing some of the reactor kinetics. Tables of reduced delayed neutron group constants for fast and thermal fission of the fissionable nuclides were prepared. (D.E.B.)

8735 NDA-14-182
Nuclear Development Corp. of America, White Plains, N. Y.
CALCULATED CRITICALITY OF THE ENRICO FERMI REACTOR DURING A HYPOTHETICAL SLOW MELTDOWN ACCIDENT. J. H. Ray and A. D. Krumbein. July 1, 1957. 22p. $4.80(ph OTS); $2.70(mf OTS).

The progress of a slow meltdown accident in the Enrico Fermi Reactor has been calculated, and a series of two-dimensional multigroup calculations has been performed to ascertain the time at which the melted reactor forms a critical configuration. The results of this series, as modified by the procedure described in this report, show that the melted configuration becomes critical approximately 5.2 sec after initiation of the accident. The rate of reactivity insertion at this time is approximately $26 per sec. It is noted that instantaneous flow of molten uranium from the core and subsequent refreezing at the top of the lower blanket have been assumed. The molybdenum in the core was not assumed to melt with the uranium. These assumptions, while not the worst that can be imagined, are sufficiently pessimistic so that a more realistic calculation of the progress of melting is expected to lead to a lower reactivity insertion rate. (auth)

8736 NMI-4352
Nuclear Metals, Inc., Cambridge, Mass.
THE EFFECT OF HYDROGEN COOLANT ON MAGNESIUM CLAD URANIUM CORE FUEL ELEMENTS. J. Paul Pemsler and J. Greenspan. Aug. 22, 1957. 22p. Contract AT(30-1)-1565. $4.80(ph OTS); $2.70(mf OTS).

The permeability of magnesium to hydrogen was measured at 350 and 450°C. Magnesium is about one-half as permeable to hydrogen as is aluminum in this temperature range. Hydrogen diffusing through the magnesium will result in a gradual hydriding of the uranium core of a magnesium clad fuel element, with a consequent dimensional change. The increase of thickness of a ribbon-type fuel element under specified conditions was calculated. The effect of fluctuations in the temperature of the fuel element and the hydrogen coolant pressure are considered and additional factors affecting the interpretation are discussed. (auth)

8737 ORNL-2500(Pts. 1-4)
Oak Ridge National Lab., Tenn.
THE ORNL GAS-COOLED REACTOR. PART I. SUMMARY REPORT. PARTS 2, 3, AND 4. PLANT DESIGN. Apr. 1, 1958. (Pt. 1, 19p.; Pt. 2, 252p.; Pt. 3, 173p.; and Pt. 4, 185p.) Contract W-7405-eng-26. (Pt. 1, $0.50 (OTS); Pt. 2, $3.00(OTS); Pt. 3, $2.25(OTS); and Pt. 4, $2.25(OTS)).

These four parts were issued separately, but are cataloged as a unit.

A conceptual design is given for a helium cooled, graphite moderated reactor using enriched UO_2 fuel in stainless steel capsules. This study is based on existing technology. The reactor is designed to produce a gross thermal power output of 687 Mw. The net electrical power output of the power plant is 225 Mw. It is suggested that the minimum design specification for such a plant should be 1000°F gas temperature. Part II contains detailed information on gas-cooled reactor physics, materials, fuel elements, and the reactor. Part III deals with the details of the gas system,

instrumentation and controls, operating procedures, and the steam system. Part IV gives the proposed plant design, the cost analysis, heat transfer performance, the reactor support and charging machine, fuel element cost data, and design data for British and U. S. gas-cooled reactors. (M.H.R.)

8738 UK/C/6/109

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

LATTICE EXPERIMENTS WITH 19-ELEMENT UO_2 RODS IN ZEEP. [Paper presented at] Sixth UK/Canada Technical Conference, Chalk River, Ontario, October 21-22, 1957. R. E. Green. Sept. 16, 1957. 14p.

ZEEP is being used to study the lattice properties of 19 element UO_2 rods and two lattices are assembled in it. They are: (a) a 24.13 cm. hexagonal lattice of 55 UO_2 rods, and (b) a 21.59 cm. hexagonal lattice of 55 UO_2 rods with 30 ZEEP rods placed around the UO_2 core with the same spacing as the core. In the first experiment, the pile did not go critical and no flux distributions were obtained. However, an estimate of the Laplacian for this lattice was made using the results of the approach-to-critical experiment. In (b) full scale flux distributions, central rod experiments and fine structure measurements were made and practically all the results quoted will be those obtained with this 21.59 cm. lattice. (auth)

8739 WAPD-CDA-126

Westinghouse Electric Corp. Bettis Plant, Pittsburgh.

RELIABILITY OF PWR FUEL ELEMENT THERMOCOUPLES AT HIGH pH WITH LiOH. P. Cohen. Dec. 11, 1957. 12p. $3.30(ph OTS); $2.40(mf OTS).

An analysis of the probability of failure of the fuel element thermocouples in the Shippingport Pressurized Water Reactor during operation at high pH with LiOH is given. The analysis confirms original estimates that the probability of failure is small, and reaffirms the original recommendation for operation at high pH with LiOH. (auth)

8740 WAPD-CDA(AD)-27

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

REVISED ESTIMATE OF PWR FISSION PRODUCT ACTIVITY WITH DEFECTIVE UO_2 FUEL RODS. F. W. Pement. [July 1957]. 3p. $1.80(ph OTS); $1.80(mf OTS).

Revised estimates of fission product activity levels in the PWR primary coolant after 300 hr steady full power operation are tabulated on the basis of 1 defected fuel rod. The revision is based on use of a purification rate constant of $1.0 \times 10^{-4} sec^{-1}$. In addition, certain values of decay constants and fission yields were changed. (M.H.R.)

8741 WAPD-PWR-PC-1154

[Westinghouse Electric Corp. Bettis Plant, Pittsburgh.]

PWR PEAK XENON REACTIVITY. [Dec. 1957]. 8p. $1.80(ph OTS); $1.80(mf OTS).

Supplement to WAPD-PWR-PCR-152.

The data presented were obtained with the aid of an analog computer. The equations used to calculate xenon and xenon reactivity can be found in the appendix of WAPD-PWR-PCR-152. Final PWR design parameters were used in the study and are presented in the appendix along with a comparison of previous design parameters used in the transient xenon study. This study investigated the equilibrium xenon reactivity for various flux levels and the peak xenon reactivity after shutdown from these flux levels. In addition, peak xenon reactivity after partial shutdown from full power was investigated. Also included are the maximum rates of xenon reactivity buildup and burnout for the flux changes considered. A short comparison of the results obtained considering the final design parameters and results previously obtained is included in tabular form. (auth)

8742 WAPD-PWR-PCR-152

[Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.]

PWR TRANSIENT XENON STUDY. A. I. Moss. June 8, 1956. 25p. Contract AT-11-1-GEN-14. $4.80(ph OTS); $2.70(mf OTS).

The effect upon the xenon concentration in the PWR core of various types of generator load demands is reported. Particular attention is given to a daily varying load cycle and the modifications to such a cycle that yield significant reductions in poison buildup. It is shown that the maximum poison transient can be significantly reduced when a minimum power level is maintained overnight during the daily load cycle. In addition, order of magnitude data for the maximum xenon burnout rate was determined. (auth)

8743 WAPD-PWR-Ph-197

Westinghouse Electric Corp. Bettis Plant, Pittsburgh.

INTERCOMPARISON OF CADMIUM–INDIUM–SILVER, HAFNIUM, AND CADMIUM–SILVER CONTROL RODS. R. F. Valentine. July 15, 1957. 5p. $1.80(ph OTS); $1.80(mf OTS).

Control rods of Cd–Ag, Cd–In–Ag, and Hf were intercompared by means of the negative buckling technique. Four group Wanda calculations of shutdown reactivity, using measured negative bucklings, were made. Results are tabulated. (W.L.H.)

8744 WAPD-PWR-(RD-1)-198

Westinghouse Electric Corp. Bettis Plant, Pittsburgh.

CORE INSTRUMENTATION READINGS. J. J. Brennan. Nov. 26, 1957. 10p. $1.80(ph OTS); $1.80(mf OTS).

Expected and upper limit readings of the core instrumentation for power operation are presented. It was assumed that the reactor heat output is 8.6×10^8 Btu/hr or 252 thermal megawatts. The expected flow rates for three loop operation, the temperature rise across each of the assemblies with exit water thermocouples for 25%, 50%, 75%, and 100% reactor heat output, and fuel plate centerline temperatures at the location of the fuel plate thermocouples are tabulated. (M.H.R.)

8745 WAPD-S5W-TH(A)-57

[Westinghouse Electric Corp. Bettis Plant, Pittsburgh.]

FLOW COASTDOWN STUDIES; EVALUATION REPORT OF TEST ON BETTIS D-LOOP, TEST SPECIFICATION 550054. William F. Cleary and L. Lyle Hylen. Nov. 15, 1956. 117p. $18.30(ph OTS); $6.00(mf OTS).

The flow coastdown studies, conducted on a simple pump and loop system, enabled empirical coastdown equations to be developed which are applicable to pressurized water reactor plants. Comparison of these equations with experimental results in two other systems is presented. Transient pump and fluid energy, and pump and system losses are discussed. An explanation of the pump and fluid interaction during the coastdown process is suggested. (auth)

8746 WAPD-SFR-G-168

[Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.]

METHODS OF RESISTING TORQUE AND LATERAL LOADS IMPOSED BY CONTROL RODS (STR CORE 4 AND SFR CORES). G. H. Cohen. Nov. 29, 1955. Decl. May 6, 1957. 7p. Contract [AT-11-1-GEN-14]. $1.80(ph OTS); $1.80(mf OTS).

The control rod assembly transmits certain torque loads and lateral forces to the reactor matrix. Methods of resisting torque and lateral loads are discussed. Core design and tests on the SFR are discussed. The small magnitude of the total load involved indicates that the problem

evolves into one of wear and alignment rather than strength. A study is made of points of greatest wear, and methods are given for minimizing the wear at these points. (A.C.)

8747 WAPD-T-545

Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
A METHOD OF OBTAINING AXIAL FLUX DISTRIBUTIONS IN A ROD-PROGRAMMED CORE. R. W. Devlin and R. R. Thomson. June 1957. 18p. Contract AT-11-1-GEN-14. $3.30(ph OTS); $2.40(mf OTS).

Presented at the American Nuclear Society Meeting, June 10-12, 1957.

A procedure for calculating pseudo three-dimensional flux distributions using one- and two-dimensional codes is described and applied to simple cases for which more exact analytical or experimental results exist. It is shown how these methods are being applied to the more complex core for which three-dimensional flux information is required, particularly a rod programmed core. (M.H.R.)

8748 WAPD-TH-282

[Westinghouse Electric Corp. Bettis Plant, Pittsburgh.]
PRESSURE DROP THROUGH BEVELLED MULTIHOLE ORIFICES IN SERIES. (PWR Blanket Design). E. R. Quandt, Jr. and B. W. LeTourneau. Dec. 6, 1956. 12p. $3.30(ph OTS); $2.40(mf OTS).

The continuation of a study of pressure drop across various combinations of staggered multihole orifice plates in series is described. Plates used in this test contained bevelled leading edge holes and were of the general design proposed for flow control in the PWR blanket region. Variables examined in this test were orifice diameters of 0.375, 0.3437, and 0.2812 in., plate spacings of 0.160, 0.300, and 0.625 in., one to six plates in series, and flow rates corresponding to orifice Reynold's numbers ranging from 15,000 to 140,000. The orifice plates and experimental methods employed in this test were similar to those described in the preceding orifice plate report. WAPD-TH-241 (41 holes on a 0.486 in. square pitch located in a 4.195 in. diameter pipe), with the exception that the present plates had a 30° bevel around the leading edge of each hole sufficient in depth to make the bevelled diameter $\frac{1}{16}$ in. larger than the hole diameter. Results are given as pressure loss coefficients (number of orifice velocity heads), and were found to be about 50% less than comparable values for square edge orifices. In general, Reynolds's number had no effect upon the loss coefficients. The loss coefficients are estimated to be accurate within ± 10% over the range investigated. (auth)

8749 WAPD-TM-95

Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
TURBO—A TWO-DIMENSIONAL FEW-GROUP DEPLETION CODE FOR THE IBM-704. J. B. Callaghan, L. M. Culpepper, J. G. Fairey, E. M. Gelbard, C. M. King, T. J. Lawton, O. J. Marlowe, and D. S. McCarty. Nov. 1957. 90p. Contract AT-11-1-GEN-14. $2.50(OTS).

TURBO is a two- or four-group depletion code in two-dimensions and is the direct counterpart of the one-dimensional code, CANDLE. The neutron flux values are computed in either x-y or r-z geometry by using a modification of PDQ. The parameters used in the diffusion equations are derived from effective one-velocity microscopic cross sections for the elements comprising the media. These elements are described by their isotopic densities and thermal self-shielding factors. The flux values obtained are normalized to a specified power output. Assuming flux and power to be constant for a specified period of time, called a time-step, the isotopic densities are recomputed according to the equations given previously. Two magnetic tapes of interest are generated during the calculation. The first, called the history tape, contains all of the information needed to continue to the next time-step, i.e., isotopic densities of time-dependent elements and converged flux values. The information needed in a thermal survey code is also saved. The second tape, called the binary output tape, contains information already calculated which may be selectively processed for printing by the output routine. The TURBO code consists of seven separate routines: the first is the x-y calculation (TURBO 1), the second is the r-z calculation (TURBO 2), the third is the maximum xenon calculation in x-y geometry (TURBO 3), the fourth is the maximum xenon calculation in r-z geometry (TURBO 4), and the fifth is the output routine (TURBO 5). The last two routines are essentially service routines. One of these, TRSE, is to be used when the End-of Tape condition is encountered on the history tape to allow the computation to continue beyond this point. The other routine, (TURBO 0) allows replacement of rectangular blocks of burnable materials or the movement of one block to another location. (auth)

8750 WAPD-TM-107

Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
THE IBM-704 SIMPL CODES. L. M. Culpepper, Eli Gelbard, James Davis, and James Pearson. Jan. 1958. 19p. Contract AT-11-1-GEN-14. $0.75(OTS).

The SIMPL-1 and SIMPL-2 Codes are designed, primarily, to solve the P_3 and double-P_1 equations in slab geometry, SIMPL-1 may be used for an entirely different purpose. In a two-group approximation, this code will compute the flux produced by a source inserted into multiplying medium. It should be noted, however, that the iterative procedure in SIMPL converges very slowly when the multiplying medium is nearly critical. In such cases, extrapolation may reduce the running time substantially. The optimum extrapolation factor, θ, may be determined from the expression $\theta = \lambda/2 - \lambda$, where λ is simply the effective multiplication factor for the reactive assembly. Convergence of P_3 and double-P_1 problems is rapid, and θ should be set equal to zero when such problems are prepared. The codes described solve the equations

$$-D_i\nabla^2\psi_i + \Sigma_{Ti}\psi_i = \chi_i\left[\sum_j\left(\nu\Sigma_f\right)_j\psi_j\right] + \Sigma_{r(i-1)}\psi_{i-1} + S_i,$$

in a central difference approximation. The difference equations are identical with the WANDA equations after deletion of the WANDA eigenvalue, λ, and insertion of the source term S_i. Extrapolation in SIMPL-1 is basically the same as in WANDA; a fission source term, S_f^{I+1}, for the I + 1 iteration is given by the expression

$$S_f^{I+1} = \sum_j\left(\nu\Sigma_f\right)_j\psi_j^I + \theta\left[\sum_j\left(\nu\Sigma_f\right)_j\psi_j^I - \sum_j\left(\nu\Sigma_f\right)_j\psi_j^{I-1}\right],$$

where θ is an input parameter. Extrapolation is not available in SIMPL-2. (auth)

8751 YAEC-66

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
MONTHLY PROGRESS REPORT FOR THE PERIOD MARCH 1 TO 31, 1958. I. H. Ceen and R. W. Garbe. Apr. 20, 1958. 17p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. $3.30(ph OTS); $2.40 (mf OTS).

The status of the various development projects associated with the Yankee Power Reactor is given. No data are reported. (For preceding period see YAEC-55.) (D.E.B.)

8752

THE "GEOMETRIC BUCKLING" OF SPHEROIDAL NUCLEAR REACTORS. N. G. Sjöstrand and A. Rentze (AB Atomenergi, Stockholm). Arkiv Fysik 13, 229-34(1958).

The Helmholtz equation $\nabla^2\phi + B^2\phi = 0$ has been solved with the boundary condition $\phi = 0$ on the surface of a spheroid. The lowest eigenvalue has been calculated for prolate and oblate spheroids of different shapes, and comprehensive tables of the "geometric buckling" of spheroidal nuclear reactors are given. (auth)

8753

WHEN WILL ATOMIC POWER PLANTS BE ECONOMICAL? THE PROSPECTS OF THE GAS COOLED REACTOR. W. Junkermann. Atomwirtschaft 3, 96-8(1958) Mar. (In German)

For economy of atomic power not only is the selection of reactor type of importance, but also the development costs which must be paid and the state of the industrial production in the necessary structural parts. The example of the further development of the Calder Hall reactors shows that the concentration on only one reactor type in an expanded atomic program leads to cost reduction. (tr-auth)

8754

FABRICATION OF FUEL ELEMENTS. H. K. Hardy (United Kingdom Atomic Energy Authority (Industrial Group), Salwick, Eng.). Atomwirtschaft 3, 99-102(1958) Mar. (In German)

The five year research and development program for industrial production of fuel elements in Great Britain is outlined. (J.S.R.)

8755

THE TRAINING OF REACTOR OPERATING PERSONNEL. Friedrich Oszuszky. Atomwirtschaft 3, 121-3(1958) Mar. (In German)

The training of operating personnel plays an important role in the economic and safe operation of power reactors as the Windscale accident shows. The operation of the Calder Hall reactor gave British personnel the possibility of training in a working power plant. The lectures, examinations, and work with the reactor simulator offered in the international course at the Calder Hall reactor control school are briefly summarized. (J.S.R.)

8756

THE "U. S. S. NAUTILUS". Energie nucléaire 2, 38-42 (1958) Jan.-Mar. (In French)

After a brief report on the principal phases in the construction of the Nautilus, some of the characteristics of the nuclear propulsion system are described. (tr-auth)

8757

CRITICAL MASS MEASUREMENTS FOR THE MERLIN RESEARCH REACTOR. D. R. Chick, K. Firth, M. Kerridge, and A. J. Salmon (Associated Electrical Industries, Ltd., Aldermaston, Eng.). Nature 181, 1171-3(1958) Apr. 26.

The Merlin research reactor is a light water-moderated reactor using highly enriched uranium fuel. A subcritical facility was built and is described for the experimental determination of the critical masses of the reactor before the reactor is made critical. The critical mass measurements for startup of the reactor are tabulated. (J.S.R.)

8758

THE FUTURE DEVELOPMENT OF GAS-COOLED REACTORS. J. R. M. Southwood (AEI-John Thompson Nuclear Energy Co., Ltd.). New Scientist 3, No. 71, 24-7(1958) Mar. 27.

When "A Programme of Nuclear Power," the program for nuclear power development in Great Britain, was published, it was thought that reactors with liquid coolants would replace the gas-cooled Calder Hall type. However, it now appears that gas-cooled reactors have a much greater potentiality for development than was thought possible. To reduce the cost of the electricity produced, the new reactors have larger cores, more fuel channels, and higher working gas pressures. The refuelling can be done while the reactor is at full load. A brief comparison is made of the economics of the gas-cooled and pressurized water reactors. (J.S.R)

8759

THE SIGNIFICANCE OF SHIPPINGPORT. Nucleonics 16, No. 4, 53-72(1958) Apr.

A special report is made on the Shippingport Pressurized Water Reactor. The specifications, engineering, power costs, and core design are discussed in detail. Data on the startup, operation, and testing of the reactor are summarized. (J.S.R.)

8760

SPIRAL FUEL ELEMENT FOR GAS-COOLED REACTORS. R. C. Dahlberg (Knolls Atomic Power Lab., Schenectady, N. Y.) and T. C. Evans (U. S. Army Corps of Engineers, Washington). Nucleonics 16, No. 4, 106-8(1958) Apr.

The fabrication and utilization of spiral fuel elements for gas-cooled reactors are described. The fuel element assembly consists of two parts: the fuel spiral and the process tube. The spiral fuel element is fabricated by cladding both sides of a thin uranium sheet and brazing parallel zirconium wires to one side of the plate in the lengthwise direction. The assembly is rolled to form a spiral with the zirconium wires maintaining a constant separation of the plate surfaces. The spiral is placed in the process tube which separates the spiral and coolant from the moderator and, if necessary, provides a pressure tube for the coolant. The unique characteristics of the spiral fuel element are briefly discussed. (J.S.R.)

8761

POLAND'S FIRST NUCLEAR REACTOR. J. Aleksandrowicz and P. Szulc (Inst. of Nuclear Research, Warsaw). Nukleonika 3, 27-41(1958), (In Polish)

The first nuclear reactor in Poland which is under construction near the Nuclear Research Center in Swierk, near Warsaw, is designed for experimental work with high-intensity neutron sources and for production of radioisotopes for research in industry and medicine. The reactor uses enriched uranium (10% U^{235}) and has a maximum capacity of 2 Mw and a maximum neutron flux of 2×10^{-13} $n/cm^2/$ sec. Data are given on the design of the reactor, the reactor building and auxiliary services, technological control, safety devices, and radiation protection of the personnel and environment. The problems involving contamination hazards in the Nuclear Research Center area are discussed. (tr-auth)

8762

THE SCIENCE AND ENGINEERING OF NUCLEAR POWER, INTRODUCTION TO PILE THEORY. Clark Goodman, ed. Cambridge, Addison-Wesley Publishing Company, Inc., 1952. 542p. $9.50.

The essentials of a series of seminars initiated at Massachusetts Institute of Technology in October, 1946, are given. The fundamentals of chain-reacting systems are presented in terms that are understandable to the nonspecialist, particularly to engineers interested in the industrial applications of nuclear energy. Chapters are included on: fundamentals of nuclear physics, the fission process, neutron diffusion, nuclear chain reactions, elementary pile theory, the application and experimental basis of pile theory, chemistry of the fission process, the control and operation of a pile, the construction of nuclear reactors, heat transfer, and heavy elements and nuclear fuels. Included in the appendices are a table of precise masses, loss of energy in elastic collisions, and neutron cross sections of the elements. (M.H.R.)

8763

THE SCIENCE AND ENGINEERING OF NUCLEAR POWER. VOLUME II. Clark Goodman, ed. Cambridge, Addison-Wesley Press, Inc., 1949. 347p. $9.50.

The second volume of a series of seminar notes presented at Massachusetts Institute of Technology is given. Specific aspects of chain-reacting systems are considered in detail. Chapters are included on: source materials for nuclear power; isotope separation; vacuum techniques in nuclear engineering; the theoretical basis of some measurements useful in pile design; research in neutron physics at Chalk River; the calculation of neutron distribution in heterogeneous piles; the concept of albedo in elementary diffusion theory; pile kinetics; the statistical aspects of pile theory; heat removal from nuclear reactors; rockets and other thermal jets using nuclear energy; the shielding of nuclear reactors; the effects of radiation on materials; the production of radionuclides; pile materials; metals, alloys and compounds; health physics; instrumentation and hazards evaluation; and future developments in nuclear energy. Included in the appendices are reviews of unclassified literature and drawings selected from a film strip produced by the United Nations on the problems of international control. (M.H.R.)

Nuclear Transformation

Refer also to abstract 8726.

8764 UCRL-8186

California. Univ., Berkeley. Radiation Lab.

SEVERAL SPALLATION REACTIONS OF URANIUM-238 PLUS HELIUM-4 (thesis). Joseph A. Coleman. Feb. 1958. 32p. Contract W-7405-eng-48. $1.00(OTS).

A radiochemical study is presented of the reactions of helium ions of energies less than 48 Mev with U^{238} to produce the spallation products U^{237}, U^{239}, Np^{238}, and Pu^{238}. A search for the product of an $(\alpha,2p)$ reaction, U^{240}, was unsuccessful. The $(\alpha,\alpha n)$, $(\alpha,2pn)$, and $(\alpha,p3n)$ reactions are discussed in terms of direct-interaction mechanisms, while the $(\alpha,4n)$ reaction appears to be typical of the well-known compound-nucleus process. Calculated values of Γ_n/Γ_t for the plutonium isotopes 239 through 242 based on the experimental cross sections of the $(\alpha,4n)$ reaction are given. On the basis of these values, theoretical excitation functions are constructed for the $(\alpha,n;\ 2n;\ 3n)$ reactions of U^{238}. (auth)

8765

GAMMA-RAY SPECTRA FROM RADIOACTIVE NEUTRON CAPTURE BY EVEN PARITY EMITTING NUCLEI WITH ROTATIONAL LEVELS. L. V. Groshev, A. M. Demidov, V. N. Lutsenko, and V. I. Pelekov. Atomnaya Energiya 4, 5-21(1958) Jan. (In Russian)

A magnetic Compton spectrometer was used in the analysis of the γ-ray spectra from thermal neutron capture by Gd, Cr, Hf, Dy, and Ta nuclei in the energy interval 0.3 to 9 Mev. For the first three elements the emitting nuclei are the even parity nuclei Gd^{156}, Gd^{158}, Er^{168}, and Hf^{178} with the system of rotational levels near the ground state. The presence of closely located intense γ lines with energies of ~1 Mev was observed in the spectra of these nuclei; however, these lines were absent in the even-odd (Dy^{165}) or odd-odd (Ta^{182}) cases of nuclear emission. The observed peculiarities of the γ spectra are related to the structure of the lower nuclear levels. (tr-auth)

8766

GAMMA RAYS FROM THE THERMAL NEUTRON CAPTURE BY RARE-EARTH NUCLEI. V. V. Sklyarevskii, E. P. Stepanov, and B. A. Obinyakov. Atomnaya Energiya 4, 22-5(1958) Jan. (In Russian)

The γ-ray spectra arising in the thermal neutron capture by nuclei of some elements were measured with a scintillation spectrometer. A series of lines was observed in the γ-ray spectra of neutron capture by Eu, Gd, Dy, Ho, Er, Tm, Hf, and Ta nuclei at energies >300 kev. Transition lines of $4^+ \rightarrow 2^+$ and $2^+ \rightarrow 0^+$ between the Er^{168} and Hf^{178} rotational levels have been found in the Er and Hf spectra. The intensities of these transitions are 0.5 to 0.8 quanta per capture. (tr-auth)

8767

REACTIONS Ga(n,p), Ge(n,p), AND Ge(n,α) WITH 14 Mev NEUTRONS. V. N. Levkovskii. Atomnaya Energiya 4, 79-80(1958) Jan. (In Russian)

The radiochemical method of separation was used to determine the yields of radioisotopes from targets of zinc and gallium. (R.V.J.)

8768

CROSS SECTION MEASUREMENT FOR THE REACTION $U^{238}(n, 2n)U^{237}$. L. E. Sherman. Atomnaya Energiya 4, 87-8(1958) Jan. (In Russian)

The cross sections for the reaction $U^{238}(n,2n)U^{237}$ was measured with a 4π counter for the absolute number of β decays formed in U^{237}. The half-life period for the recovered U^{237} was 6.5 days. (R.V.J.)

8769

SOME PHOTONEUTRON THRESHOLDS. B. G. Chidley, L. Katz, and S. Kowalski (Carnegie Inst. of Tech., Pittsburgh). Can. J. Phys. 36, 407-14(1958) Apr.

The photoneutron thresholds for a number of elements which have 100% abundance (or nearly so) in one stable isotope have been measured. The following values in Mev were found: Na (12.47 ± 0.05), Al (12.98 ± 0.08), P (12.50 ± 0.05), V (11.16 ± 0.05), Mn (10.14 ± 0.05), Co (10.44 ± 0.05), As (10.24 ± 0.05), Y (11.82 ± 0.05), Nb (8.86 ± 0.05), Rh (9.46 ± 0.08), I (9.14 ± 0.05), Cs (9.11 ± 0.05), La (8.81 ± 0.05), Pr (9.46 ± 0.05), Tb (8.16 ± 0.05), Ho (8.10 ± 0.05), Tm (8.00 ± 0.05), Ta (7.66 ± 0.05), and Au (7.96 ± 0.07). (auth)

8770

PHOTONEUTRON THRESHOLD AND CROSS SECTION FOR $_{71}Lu^{175}$. H. J. King and L. Katz (Univ. of Saskatchewan, Saskatoon, Can.). Can. J. Phys. 36, 415-18(1958) Apr.

The neutron yield resulting from photoneutron reactions in Lu^{175} has been measured as a function of peak bremsstrahlung energy up to 23 Mev. The threshold energy for this reaction was found to be 7.77 ± 0.05 Mev. The giant resonance cross section has a peak value of 225 millibarns at 16 Mev, a half-width of 8.4 Mev, and an integrated cross section to 23 Mev of 1.9 Mev-barns. (auth)

8771

THE THERMAL-NEUTRON FISSION CROSS SECTION OF Pu^{240}. C. B. Bigham (Atomic Energy of Canada, Ltd., Chalk River, Ont., Can.). Can. J. Phys. 36, 503-7(1958) Apr.

A measurement of the thermal-neutron fission cross section of Pu^{240} is described. The value obtained, −0.8 ± 0.7 barn, is compared with other measurements. (auth)

8772

NEUTRON PRODUCTION AT HIGH ENERGIES. Walter E. Crandall and George P. Millburn (Univ. of California, Livermore). J. Appl. Phys. 29, 698-704(1958) Apr.

Neutron yields from several targets bombarded by deuterons, protons, neutrons, and He^3 ions with energies of hundreds of Mev were measured by detecting the neutrons

with $MnSO_4$ solution. The effect of secondary targets of U and Th in multiplying the primary yield was investigated, and the energy dependence for Be and U targets bombarded by deuterons was measured for energies between 90 and 320 Mev. The data were analyzed in terms of the average number of neutrons produced in an inelastic collision; the largest number observed was 17 for 340-Mev protons bombarding U. The data are in reasonable agreement with evaporational theory and Monte Carlo calculations. (auth)

8773

ALPHA PARTICLES FROM THE INTERACTION OF 14.8-Mev NEUTRONS WITH MEDIUM WEIGHT NUCLEI. Isao Kumabe (Univ. of Kyoto). J. Phys. Soc. Japan 13, 325-34 (1958) Apr.

The angular and energy distributions of alpha particles resulting from $V^{51}(n,\alpha)Sc^{48}$ and $S^{32}(n,\alpha)Si^{29}$ reactions induced by 14.8 Mev neutrons were measured with Ilford C2 nuclear plates. It was found that the angular distributions for the entire energy regions in the center-of-mass system are concave upward and approximately 90° symmetrical, and the energy distributions show that more alpha particles with energies below the Coulomb barrier are emitted than expected. Also the curve on a semilog plot of the relative level density calculated from the energy distributions of the alpha particles fits a straight line which would correspond to Maxwellian distributions with the temperatures of about 0.9 Mev for Sc and about 1.5 Mev for Si. The total cross sections of V and S are 126 mb ± 15% and 109 mb ± 15%, respectively. Experimental data on (n,α) reaction are summarized and discussed in detail. (auth)

8774

EXCITATION FUNCTION FOR $Fe^{56}(n,p)Mn^{56}$. J. Terrell and D. M. Holm (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 109, 2031-5(1958) Mar. 15.

The relative cross section for $Fe^{56}(n,p)Mn^{56}$ has been measured by an activation method for neutron energies of 3.4 to 8.2 and 12.4 to 17.9 Mev, and normalized to the previously known value of 110 ± 10 mb at 14.3 Mev. The cross section rises above the minimum detectable value of 0.2 mb at about 4.5 Mev, reaches a maximum of 116 mb at 13.5 Mev, and decreases to 62 mb at 17.9 Mev. The experimental results are compared with the predictions of statistical theory; the fit, although good in the vicinity of maximum yield, is poor at lower energies, the predicted yield being considerably too small. Cross sections for $Fe^{54}(n,2n)Fe^{53}$ were also roughly determined at 16.9 and 17.9 Mev. (auth)

8775

ANGULAR DISTRIBUTION OF PHOTOPROTONS FROM DEUTERIUM FROM 9 TO 23 Mev. A. Whetstone and J. Halpern (Univ. of Pennsylvania, Philadelphia). Phys. Rev. 109, 2072-8(1958) Mar. 15.

Photoprotons from a deuterated paraffin target irradiated with betatron x rays have been detected with a NaI(Tl) scintillator. The angle and energy of the protons have been measured, and the data have been fitted to the angular distribution form $f(\theta) = (A + B\sin^2\theta)(1 + 2\beta\cos\theta)$. The ratio A/B rises from a value of 0.015 ± 0.041 for the 9- to 12-Mev photon group to a value of 0.133 ± 0.020 for the 20- to 23-Mev group. A/B increases in a complicated way suggesting several contributions to the isotropic component. The value determined for β agrees with the calculation of ν_p/c. A Schiff thin-target spectrum is assumed for the incident photons, and the cross section obtained is consistent with the Marshall and Guth calculations, although the energy dependence of the data has slightly less slope than the calculated values. (auth)

8776

(p,n) CROSS SECTIONS OF COPPER AND ZINC. H. A. Howe (Univ. of California, Los Angeles). Phys. Rev. 109, 2083-5(1958) Mar. 15.

The (p,n) reaction cross sections of Cu^{63}, Cu^{65}, Zn^{64}, Zn^{65}, and Zn^{68} were measured at energies up to 12 Mev. The energy dependence agrees with that predicted by the Shapiro calculations, but the large variation of cross section among these nuclides suggests that interactions, other than compound nucleus formation, are taking place at these energies. The threshold of the reaction $Zn^{64}(p,n)Ga^{64}$ was determined, giving Q = −7.8 ± 0.15 Mev. (auth)

8777

NUCLEAR LEVELS IN P^{30}, S^{33}, AND S^{35}. P. M. Endt (Rijksunversiteit, Utrecht) and C. H. Paris (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 110, 89-95(1958) Apr. 1.

Targets of natural antimony sulfide have been bombarded with deuterons accelerated by the MIT-ONR electrostatic generator to energies of 6.0 and 6.5 Mev. Charged reaction products, protons, alpha particles, and elastically scattered deuterons, were observed at angles of 50, 90, and 130 degrees to the deuteron beam with a high-resolution, broad-range magnetic spectrograph. The ground-state Q value of the $S^{32}(d,\alpha)P^{30}$ reaction is measured as 4.887 ± 0.010 Mev. The previously reported first level in P^{30} appears to be a doublet with components at 0.680 and 0.708 Mev. On intensity grounds, an isobaric spin T = 1 is assigned to the lower level. Twenty-eight additional levels in P^{30} are observed in a region of excitation up to 5.8 Mev. The ground-state Q value of the $S^{32}(d,p)S^{33}$ reaction is 6.413 ± 0.006 Mev, and one hundred four levels are observed up to an excitation energy of 8.0 Mev. Some levels stand out as single-particle states because of the high intensities of the corresponding proton groups. Six weak proton groups were assigned to the $S^{34}(d,p)S^{35}$ reaction. The ground-state Q value is 4.757 ± 0.010 Mev. (auth)

8778

INVESTIGATION OF FOUR RESONANCES IN THE REACTION $Si^{29}(p,\gamma)P^{30}$. C. van der Leun and P. M. Endt (Rijksuniversiteit, Utrecht). Phys. Rev. 110, 96-104(1958) Apr. 1.

Thin Si^{29} targets have been bombarded with protons from a Cockcroft-Walton generator in the energy region E_p = 0.2 to 0.8 Mev. The gamma radiation from the $Si^{29}(p,\gamma)P^{30}$ reaction has been investigated with a NaI scintillation spectrometer at the 326-, 414-, 693-, and 729-kev resonances. Pulse spectra taken at each resonance at angles of $\theta = 0$ and $\theta = 90$ degrees to the proton beam were analyzed with a 70-channel Hutchinson-Scarrott kicksorter. The decay of the resonance levels was further investigated by γ-γ coincidence measurements. The following spins, J, parities, and isobaric spins, T, could be assigned to P^{30} levels: Ground state, $J = 1^+$, T = 0; 0.684 Mev, $J = 0^+$, T = 1; 0.706 Mev, $J = 1^+$, T = 0; 1.45 Mev, $J = (2^+)$, T = 0; 2.94 Mev, $J = 2^+$, T = 1; 4.18 Mev, $J = 2^+$, T = 1; 5.88 Mev, $J = 2^-$, T = 1; 5.96 Mev, $J = 1^-$, T = 0; 6.23 Mev, $J = 1^-$, T = 1; 6.27 Mev, $J = 3^-$, T = 0. The reaction Q value is measured as Q = 5.570 ± 0.030 Mev. From absolute gamma-ray yield measurements, the radiation widths of all resonance levels could be determined. These levels are shown to have T as a good quantum number. The strong gamma rays are of E1 character and satisfy the isobaric-spin selection rule for self-conjugate nuclei. (auth)

8779

POLARIZATION OF PROTONS FROM $B^{10}(d,p)B^{11}$, $C^{12}(d,p)C^{13}$, AND SPIN-FLIP STRIPPING. J. C. Hensel and

W. C. Parkinson (Univ. of Michigan, Ann Arbor). Phys. Rev. 110, 128-35(1958) Apr. 1.

The polarization of proton groups corresponding to the ground and first excited states in the reactions $B^{10}(d,p)B^{11}$ and $C^{12}(d,p)C^{13}$ have been measured for an incident deuteron energy of 7.8 Mev. With the exception of the first excited state of B^{11}, the sign of the polarization for six known cases is consistent with the relation $P = (\pm)$ when $j_n = l_n \pm \frac{1}{2}$, the axis of quantization being defined by $n = k_p \times k_d$. The anomalous polarization of the first excited state of B^{11} is interpreted as evidence for a spin-flip exchange process in the stripping reaction. (auth)

8780

ACTIVATION CROSS SECTION FOR THE REACTION $Na^{23}(n,p)Ne^{23}$. Claude F. Williamson, Emmet L. Hudspeth, I. L. Morgan, and R. G. Moore (Univ. of Texas, Austin). Phys. Rev. 110, 139-42(1958) Apr. 1.

The absolute reaction cross section for $Na^{23}(n,p)Ne^{23}$ has been measured in the range of neutron energies from 3.3 Mev to 8.2 Mev by use of neutrons from the reactions $H^2(d,n)He^3$ and $N^{14}(d,n)O^{15}$. The cross section rises from a threshold at about 3.7 Mev to 12 mb at the highest energy studied. Twelve resonances are observed corresponding to excited levels in Na^{24}. The region of energy overlap between the neutrons from $H^2(d,n)He^3$ and $N^{14}(d,n)O^{15}$ gives values of the $N^{14}(d,n)O^{15}$ cross section which are in rough agreement with those previously measured elsewhere. Over-all accuracy is estimated to be ±20% for $H^2(d,n)He^3$ data, and ±5% for $N^{14}(d,n)O^{15}$ data. (auth)

8781

ANOMALOUS BEHAVIOR OF $Al^{27}(p,\alpha)Mg^{24}$ DIFFERENTIAL CROSS SECTIONS. G. E. Fischer, V. K. Fischer, E. A. Remler, and M. D. Tatcher (Columbia Univ., New York and Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 110, 286-7(1958) Apr. 1.

The partial success of Butler's direct interaction theory in fitting the experimental $C^{12}(\alpha,p)N^{15}$ angular distributions suggested an investigation of (p,α) reactions. The differential cross sections of $Al^{27}(p,\alpha_0)Mg^{24}$ (Q = 160 Mev) and $Al^{27}(p,\alpha)Mg^{24}$ (Q = −0.23 Mev) have been measured for protons of approximately 11 Mev from the Brookhaven 60-inch cyclotron. A theoretical curve was calculated from Eq(58) of Butler's paper (S. T. Butler, Phys. Rev. 106, 272(1957)) for 10.9 Mev protons. The nuclear radius, $\gamma = 4.50 \times 10^{-13}$ cm, was that which gave the best fit to the minimum and second maximum. Butler's theoretical expression predicts less forward peaking than is observed for (α,p) reactions. (A.C.)

8782

PRELIMINARY NOTE ON THE INDIRECT (p, t) PROCESS. Hitoshi Hagiwara (Hosei Univ., Tokyo) and Makoto Tanifuji (Univ. of Tokyo and Hosei Univ., Tokyo). Progr. Theoret. Phys. (Kyoto) 18, 322-4(1957) Sept.

The analogous method to the indirect (p,d) process is used to calculate the indirect (p,t) process according to the successive pick-up mode, and the contributions from the paired pick-up mode are also discussed. The results of the calculations are tabulated for several elements. (A.C.)

8783

SOME CHARACTERISTICS OF M1-CONVERSION NUCLEAR TRANSITIONS. D. P. Grechukhin. Soviet Phys. JETP. 6, 144-9(1958) Jan.

M1-conversion nuclear transitions are investigated within the framework of the single-particle model with LS coupling. (auth)

8784

A SENSATIONAL DISCLOSURE. G. Anfilov. Znaniye Sila No. 5, 1-5(1957) May.

The possibility of fusing deuterium nuclei by means of special catalyzers such as muons at low temperatures is discussed. (J.S.R.)

Particle Accelerators

Refer also to abstract 8247.

8785 AECU-3670

Washington. Univ., Seattle.

ANNUAL PROGRESS REPORT FOR YEAR ENDING JUNE 15, 1957 [ON] CYCLOTRON RESEARCH. 64p. Contract AT(45-1)-293. $10.80(ph OTS); $3.90(mf OTS).

Work was done on the elastic scattering of alpha particles by medium-weight and heavy elements, on the inelastic scattering of alpha particles from light nuclei, on the problem of the radiative capture of alpha particles, and on mass and angular distributions of fission fragments. It was found that Be^{9*} (2.43 Mev) decays predominantly into $He^5 + He^4$. An "orange" type beta spectrometer for the study of short-period high energy spectra is under construction. Angular distributions of protons from the reaction $C^{12}(\alpha,p)N^{15}$ proceeding to ground state at incident energies of 41.5 and 30.5 Mev are given. The design of a flexible two-dimensional pulse height analyzer for use in coincidence experiments was undertaken and progress was made in the design and construction of a 60-in. scattering chamber. (M.H.R.)

8786 MURA-215

Midwestern Universities Research Assn., Madison, Wis.

SUPPRESSION OF BETATRON OSCILLATION EXCITATION (R. F. KNOCKOUT) BY THE R. F. ACCELERATING SYSTEM OF A FIXED FIELD ACCELERATOR. D. W. Karst. Feb. 7, 1957. 9p. Contract AT(11-1)-384. $1.80 (ph OTS); $1.80(mf OTS).

Two recent suggestions for avoiding radio frequency knock-out of a beam due to r-f excitation of betatron oscillations are discussed. The first is the use of two cavities tipped to give electric fields at angles $\Phi_1 = \pm \Phi_2$ with the equilibrium orbit and spaced so that ζ radians of betatron oscillation can occur between them with $\text{Tan } \Phi_1 = -\nu_x/k + 1\ (1 + \cos \zeta/\sin \zeta)$. The r-f phase must travel from one cavity to the other with the speed of the stacked particles. The second suggestion is that it is possible to turn off the cavity voltage briefly while it is passing the r-f k-o frequency without losing an appreciable number of particles and probably without enlarging the dimensions of the stacked beams seriously. (auth)

8787 MURA-217

Midwestern Universities Research Assn., Madison, Wis.

COUPLED NON-LINEAR RESONANCES IN ALTERNATING GRADIENT ACCELERATORS. George Parzen. Feb. 20, 1957. 28p. $4.80(ph OTS); $2.70(mf OTS).

The method presented in a previous paper for treating the non-linear resonances in alternating gradient type of high energy accelerators was extended to treat the two dimensional coupled resonances. The sum resonance $2\nu_y + \nu_x = N$ is treated in detail and the same methods can be applied to the higher order sum resonances. The difference resonances are not treated. The results of the theory are compared with those of a numerical calculation. (auth)

8788 ORNL-2434

Oak Ridge National Lab., Tenn.

ELECTRONUCLEAR RESEARCH DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING OCTOBER 1, 1957. Apr. 29, 1958. 65p. Contract W-7405-eng-26. $2.00(OTS).

In heavy-particle physics the 28-Mev N^{3+} ions accelerated with the ORNL 63-Inch Cyclotron are used in studies of transfer reactions in which a nucleon is transferred from one nucleus to the other, and in studies of reactions in which the two nuclei fuse and there is an emission of light particles. The deflector system installed in the ORNL 86-Inch Cyclotron has proved to be very reliable. The machine is being used for a wide range of studies of proton-induced reactions in the medium-energy field, as well as for the production of radioisotopes for research and medical uses. The successful operation of a 200-kev electron cyclotron has shown the feasibility of accelerating particles well into the relativistic region with a fixed-frequency cyclotron in which azimuthal variations in the magnetic field keep the ions focused toward the median plane. Further tests and design studies are being made in order to apply this principle to an f-f cyclotron for accelerating large currents of protons to 900 Mev. The preparation of highly enriched isotopes of uranium, thorium, and plutonium was continued. A small 24-in. isotope separator was developed for the separation of small quantities of radioactive feed materials. The Army Package Power Reactor, APPR-1, originally designed at the Laboratory, has shown excellent operational characteristics in performance tests. Development tests and consultation service for this and similar reactor programs were continued. (For preceding period see ORNL-2139.) (auth)

8789 UCRL-8092

California. Univ., Berkeley. Radiation Lab.

CALIBRATION OF THE BEVATRON BEAM-INDUCTION ELECTRODES. Harry G. Heard. Jan. 1958. 11p. Contract W-7405-eng-48. $0.50(OTS).

Three sets of electric-induction electrodes are used in the Bevatron to yield measures of the quantity of charge in the bunched proton beam. This report considers a refined calibration of these electrodes. It is shown that the quantity of charge in the beam may be obtained directly by measuring the amplitude of the first-harmonic component of the voltage pulses resulting from charge induced on the electrode by the circulating beam. Although changes in the configuration of the induced voltage pulse alter the phase and magnitude of the harmonic content, it is shown that the ratio of the first-harmonic component to the average value is essentially unaffected. Fourier analyses of typical beam-pulse wave forms indicate that it is possible to determine the beam charge to within 2% at any beam energy by measuring the amplitude of the first-harmonic component of the voltage pulse. Electronic equipment is provided that measures the beam charge to within less than ±4%. (auth)

8790 UCRL-8114

California. Univ., Berkeley. Radiation Lab.

BEVATRON OPERATION AND DEVELOPMENT. PART XV. [Period covered] August, September, October 1957. Walter Hartsough. Jan. 10, 1958. 22p. Contract W-7405-eng-48. $0.75(OTS).

The interactions and decay of K mesons were studied by use of a 10-inch liquid hydrogen bubble chamber and a 30-inch propane bubble chamber. A counter experiment was done to detect asymmetries in K-μ-e decay. The study of π^0 modes of heavy-meson and hyperon decay continued, using counters. An experiment was done to detect antineutrons in coincidence with He^3 production. Twenty-three target bombardments in the internal proton beam were made for the Chemistry group. A pulsed air-core magnet to generate short secondary-particle beam pulses was installed in the south straight section. External proton beam studies were continued, using an energy-loss target and a pulsed magnetic beam deflector. (For preceding period see UCRL-8022.) (auth)

8791

A COMPARATIVE STUDY OF BETATRON AND DIRECT INJECTION IN THE ELECTRON SYNCHROTRON PROPOSED FOR THE INSTITUTE OF NUCLEAR PHYSICS, CALCUTTA. M. N. Viswesvariah and S. K. Sen (Inst. of Nuclear Physics, Calcutta). Indian J. Phys. 32, 66-74 (1958) Feb.

The operation of an electron synchrotron in relation to the types of injection is described briefly, and the capture efficiency at the time of start of the synchrotron phase of motion has been calculated. In the two cases the approach of calculation has been different depending on the fact that the motion of electrons towards the end of the betatron phase and the motion at the time of injection from the external injector are different. The merits of the two types of injection are discussed. (auth)

8792

A CYCLOTRON WITH SECTIONAL MAGNET. E. M. Moroz (P. N. Lebedev Physics Inst., Academy of Sciences, USSR). Soviet Phys. (Doklady) 1, 326-9(1956) May-June.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 1359

8793

A "SYMMETRIC" CIRCULAR SYNCHROCYCLOTRON WITH OPPOSITELY DIRECTED BEAMS. A. A. Kolomenskii (P. N. Lebedev Physics Inst., Academy of Sciences, USSR). Soviet Phys. JETP. 6, 231-3(1958) Jan.

A "symmetric" circular synchrocyclotron is suggested as a means of achieving the collision of beams travelling in opposite directions in a single accelerator. The instrument is a strong-focusing accelerator with a magnetic field constant in time and composed of sectors with oppositely directed fields. (J.S.R.)

8794

APPLICATION OF THE EINSTEIN-FOKKER EQUATION TO FINDING PARTICLE LOSSES DUE TO GAS SCATTERING IN ACCELERATORS. B. M. Bolotovskii and A. P. Fateev (P. N. Lebedev Physics Inst., Academy of Sciences, USSR). Soviet Phys. JETP. 6, 237-9(1958) Jan.

The losses caused by multiple inelastic interactions were calculated on the basis of the Einstein-Fokker equation for a 250-Mev synchrotron and for a 10-Bev proton synchrotron. For the 250-Mev synchrotron the losses are negligible, but in a 10-Bev proton synchrotron the losses correspond to several percent. (J.S.R.)

Radiation Absorption and Scattering

Refer also to abstract 8589.

8795 IFA-FT-25

Academia R. P. R. Institutul de Fizică Atomică, Bucharest.

RADIATIVE CORRECTIONS TO COMPTON SCATTERING. (Corectiile Radiative la Efectul Compton.) C. Eftimiu. 1956. 8p.

The radiative corrections to Compton scattering are computed by using Dyson's method. The coincidence of results obtained by using the two methods (Dyson's subtraction and Pauli-Villars' regularization) of elimination of the divergences appearing for large values of the virtual moments is discussed. In the latter case the experimental mass of the + Δm where m ~ Σ(im) must be considered, including then the graphs containing electronic self energy parts in the external lines. (M.H.R.)

8796 LAMS-2182
Los Alamos Scientific Lab., N. Mex.
SIZE RESONANCES IN PROTON SCATTERING. Charles E. Porter, S. Blumberg, I. Cherry, M. Goldstein, G. Igo, and R. Thaler. Feb. 1958. 36p. Contract W-7405-eng-36. $1.00(OTS).

An example of size resonance effects in proton scattering is presented in which numerical calculations were carried out for manganese, using an optical model composed of a so-called Saxon potential for the nuclear part of the potential and a Ford-Hill potential for the charge part. The size resonance effects appear most noticeably in the cross section for compound nucleus formation. In the angular distributions of the elastically scattered protons, there is deviation from pure Coulomb scattering considerably below the barrier height. (auth)

8797
THE SCATTERING OF NUCLEONS BY ALPHA-PARTICLES. P. E. Hodgson (Univ. of Reading). Advances in Phys. 7, 1-39(1958) Jan.

A collection of the essential experimental results and the main lines of theoretical explanation is presented as an integrated whole. Nuclear collisions are considered in terms of the total cross section, differential cross section, inelastic collisions, meson production, polarization, Coulomb scattering, resonance theory, phase-shift analysis, and phenomenological theories. (W.D.M.)

8798
A METHOD TO DETERMINE THE CHARGE OF PARTICLES STOPPING IN NUCLEAR EMULSIONS. Tage Johansson (Univ. of Lund). Arkiv Fysik 13, 129-44(1958).

An investigation is described of a photometric method for the determination of the charge of particles stopping in nuclear emulsions. The image of the track in the emulsion was projected on a narrow slit placed in front of a photomultiplier and moved perpendicularly across the slit. The slit was parallel to the direction of the track and the absorption of light was measured by means of the photomultiplier and a recording instrument. The resolving power depends on the available track length, the quality and the degree of development of the emulsions. If track lengths of 100 μ are used in normally developed G 5 emulsions of good quality it is possible to separate doubly and singly charged particles in about 95% of the cases, the resolution being better for multiply charged particles. (auth)

8799
ON THE SCATTERING OF SLOW NEUTRONS BY KCl. Alf Sjölander (Univ. of Uppsala). Arkiv Fysik 13, 199-214(1958).

Numerical calculations of the coherent and incoherent one-phonon scattering of slow neutrons by a single KCl crystal are presented. The one-phonon scattering surfaces for a series of neutron energies and some different crystal settings have been determined on the basis of the eigen frequencies obtained by Tenerz when using a realistic model of KCl. Rough estimates of the scattering intensities have also been made. (auth)

8800
ON TWO-PHONON PROCESSES IN NEUTRON DIFFRACTION AGAINST CRYSTALS. Alf Sjölander (Univ. of Uppsala). Arkiv Fysik 13, 215-28(1958).

The two-phonon processes in slow neutron scattering against single crystals are discussed. It is shown that in the harmonic approximation the energy distribution of neutrons scattered coherently in a certain direction in some cases has logarithmic singularities for the energies obtained in the one-phonon processes. Further there appear singularities of the same kind as Van Hove found earlier for the incoherent one-phonon scattering. To illustrate the logarithmic singularities more explicit results are given for an ideal Debye crystal. A formula for the incoherent two-phonon scattering is also given, and this is applied on KCl. (auth)

8801
ANGULAR ENERGY FLUX OF SECONDARY GAMMA-RAYS IN MATTER: SMALL-ANGLE SCATTERING FROM A POINT ISOTROPIC SOURCE. W. R. Dixon (National Research Council, Ottawa, Can.). Can. J. Phys. 36, 419-30(1958) Apr.

The distribution in energy and angle of secondary gamma-rays in matter is studied, with particular reference to small angles and to energies near the incident energy. The "angular energy flux" arising from a point isotropic source in matter is calculated, using small-angle approximations, and compared with experimental data obtained for a Cs^{137} source in concrete. It is concluded that for small angles and for energies near the incident energy, only a few orders of scattering contribute to the angular energy flux out to considerable thicknesses, whereas for large angles and low energies many orders of scattering contribute even for small thicknesses. (auth)

8802
APPROXIMATE DISPERSION RELATIONS FOR NUCLEON-NUCLEON SCATTERING. V. Z. Blank and P. S. Isaev (Joint Inst. of Nuclear Research). Doklady Akad. Nauk S.S.S.R. 117, 785-7(1957) Dec. 11. (In Russian)

Dispersion relations are written for nucleon-nucleon scattering in the absence of antinucleons. (R.V.J.)

8803
HIGH ENERGY NEUTRON-PROTON SCATTERING WITH SPIN-ORBIT INTERACTION. H. N. Yadav and L. S. Singh (Patna Univ., India). Indian J. Phys. 32, 80-90(1958) Feb.

The angular distribution and total cross sections have been calculated for high energy n−p scattering in the energy range 83 to 415 Mev (laboratory system). The interaction considered is of a symmetrical type with spin-orbit and tensor force in the triplet states. Yukawa potential has been used with ranges 1.18×10^{-13} cm and 1.60×10^{-13} cm in the singlet and triplet states respectively. The parameters of the potential are fitted to explain the low energy scattering cross section and the properties of the deuteron. The calculated high-energy cross sections are, as usual, large. The symmetrical meson theory with tensor force and spin-orbit interaction does not seem to be capable of explaining the high-energy scattering data. (auth)

8804
PHASE SHIFTS FOR p−α SCATTERING AND POLARIZATION IN p−α SCATTERING FOR PROTON LABORATORY ENERGIES FROM 0 TO 40 Mev. J. L. Gammel and R. M. Thaler (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 109, 2041-7(1958) Mar. 15.

The phase shifts for p−α scattering as a function of energy are known below about 10 Mev from previous phase-shift analysis work. New scattering and polarization data at 17.5 Mev and scattering data at 40 Mev make possible the extrapolation of these phase shifts up to about 40 Mev. This is accomplished by means of phase-shift analyses of the data, taken together with an analysis in terms of an effective two-body potential. It is found that the polarization in p−α scattering is always large in this energy region. Curves are given for the angular distribution of polarization in the energy range 10 to 40 Mev. (auth)

8805
ANGULAR DISTRIBUTIONS OF ELASTIC SCATTERING OF 5-Mev NEUTRONS. R. W. Hill (Westinghouse Research Labs., Pittsburgh). Phys. Rev. 109, 2105-10(1958) Mar. 15.

The differential cross sections for elastic scattering of

5-Mev neutrons from C, O, Al, Fe, Ni, Cu, Mo, Ba, W, and Pb were measured over an angular range between 30° and 150° The experimental values are compared with the predictions of a diffuse-surface optical model. (auth)

8806

ELECTRON SCATTERING BY POLARIZED NUCLEI. Roger G. Newton (Indiana Univ., Bloomington). Phys. Rev. 109, 2213-14(1958) Mar. 15.

8807

PARAMAGNETIC AND NUCLEAR SCATTERING CROSS SECTIONS OF HOLMIUM SESQUIOXIDE. W. C. Koehler, E. O. Woolan, and M. K. Wilkinson (Oak Ridge National Lab., Tenn.). Phys. Rev. 110, 37-40(1958) Apr. 1.

The coherent neutron scattering cross section of Ho as determined from neutron diffraction measurements on Ho_2O_3 is found to be (9.1 ± 0.5) b with amplitude of positive phase. The total nuclear scattering cross section is estimated to be about 13 b. The magnitude and angular dependence of the differential cross section for paramagnetic scattering by the trivalent holmium ion in Ho_2O_3 have been measured at room temperature. For small scattering angles the observed cross section is equal, within experimental error, to that calculated for the free-ion moment, i.e., 10.6 Bohr magnetons, and the angular dependence of the differential scattering cross section reflects the full contribution of the orbital as well as of the spin contribution to the total moment of the ion. (auth)

8808

THERMAL INELASTIC SCATTERING OF COLD NEUTRONS IN POLYCRYSTALLINE GRAPHITE. II. P. G. Khubchandani. L. S. Kothari, and K. S. Singwi (Atomic Energy Establishment, Trombay, Bombay). Phys. Rev. 110, 70-2(1958) Apr. 1.

Inelastic scattering cross section of cold neutrons in polycrystalline graphite is calculated without using the incoherent approximation. The present calculations, though they are an improvement upon those reported in an earlier paper, are still unable to explain satisfactorily the observed variation of cross section with neutron wavelength. Calculations of some typical scattering surfaces in graphite are also given, revealing some interesting features. (auth)

8809

ELASTIC SCATTERING OF 40-Mev PROTONS BY DEUTERONS. John H. Williams and Morton K. Brussel (Univ of Minnesota, Minneapolis). Phys. Rev. 110, 136-8(1958) Apr. 1.

Measurements of the differential cross section for elastic elastic scattering of 40-Mev protons by deuterons over the range of proton laboratory angles from 4° to 164° are reported. The results for angles greater than 90° were obtained by observing the recoil deuterons emitted in the forward direction. The cross section exhibits a sharp minimum at 7° and a broad minimum at approximately 110°. (auth)

8810

BACK-ANGLE ELASTIC SCATTERING OF 14.6-Mev NEUTRONS. J. D. Anderson, C. C. Gardner, M. P. Nakada, and C. Wong (Univ. of California, Livermore). Phys. Rev. 110, 160-3(1958) Apr. 1.

Differential elastic scattering cross sections have been obtained for 14.6-Mev neutrons on Fe, Ag, Cd, Sn, and Pb in 5° steps from 90° to 167°. Time-of-flight techniques and one-meter radius rings were used to reduce background, obtain reasonable counting rates, and preserve angular resolution. Optical model calculations by Bjorklund and Fernbach indicate that a spin-orbit coupling term is needed to fit the data. (auth)

8811

PROTON POLARIZATION MEASUREMENTS NEAR 18 Mev. Karl W. Brockman, Jr. (Princeton Univ., N. J.). Phys. Rev. 110, 163-9(1958) Apr. 1.

Polarization of protons in proton-helium scattering may be calculated from phase shifts obtained from differential cross section measurements. Calculations of this type were performed for energies up to 18 Mev. On the basis of these results, an instrument was built with which proton polarizations could be measured for protons with energies from 5 Mev to 18 Mev and beyond. A second polarization analyzer was built utilizing the discovery of polarization in the scattering of protons by carbon around 17 Mev. Results are given for polarization measurements on H, D, Be, C, and Al near 18 Mev. Angular distributions for polarization in both elastic and inelastic (4.4-Mev excitation) scattering by carbon are also reported. (auth)

8812

DEPOLARIZATION OF A POSITRON BEAM BY MULTIPLE SCATTERING. S. M. Neamtan (Univ. of Manitoba, Winnipeg, Can.). Phys. Rev. 110, 173-4(1958) Apr. 1.

On the assumption of a multiple scattering process, a formula is derived for the depolarization of a positron beam in being slowed down in matter. In its general form, the formula is applicable not only to positrons but to any Fermions. (auth)

8813

DISPERSION RELATIONS IN NUCLEON-NUCLEON SCATTERING. Sakahiko Matsuyama and Hironari Miyazawa (Univ. of Tokyo). Progr. Theoret. Phys. (Kyoto) 18, 328-9(1957) Sept.

The dispersion relation in quantum field theory has been successfully applied to pion-nucleon scattering. When applied to the case of nucleon-nucleon scattering, it leads to a new relation between the scattering amplitudes and a quantity which is intimately connected with the two-body nuclear potential. A brief account of this formula is presented. (A.C.)

8814

DAMPED SCATTERING OF SPINLESS PARTICLES. A. A. Sokolov and B. K. Kerimov (M. V. Lomonosov Moscow State Univ.). Soviet Phys. (Doklady) 1, 345-9(1956) May-June.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 735.

8815

SMALL ANGLE ELASTIC PROTON-PROTON SCATTERING AT 460, 560 AND 660 Mev. N. P. Bogachev (Inst. of Nuclear Problems, Academy of Sciences, USSR). Soviet Phys. (Doklady) 1, 361-3(1956) May-June.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 1365.

8816

POLARIZATION IN (p-p) SCATTERING AT 635 Mev. M. G. Meshcheriakov, S. B. Nurushev, and G. D. Stoletov (Joint Inst. for Nuclear Research). Soviet Phys. JETP. 6, 28-35(1958) Jan.

The angular distribution of polarization arising in (p-p) scattering was studied in the range $11.6 \leq \theta \leq 90.3°$ (cms) by means of single and paired telescopes of scintillation counters. A proton beam of 635 Mev energy and polarization of 0.58 ± 0.03 was employed. An analysis of the results of measurement of the differential cross-sections $\sigma_0(\theta)$ for elastic scattering of 657 Mev unpolarized protons, was performed on basis of the optical model of (p-p) scattering with the aim of establishing the nature of interference between the Coulomb and nuclear scattering amplitudes. The polarization data can be satisfactorily approxi-

mated. The presence of the term $\sin\theta\cos\theta\,P_4(\cos\theta)$ in this formula indicates that triplet F-states play an important role in the scattering. It is found that at 635 Mev the polarization in quasi-elastic (p-p)-scattering by beryllium comprises about 85% of the polarization of protons scattered by hydrogen. (auth)

8817

ELASTIC SCATTERING OF 580 Mev NEUTRONS BY PROTONS IN THE LOW ANGLE REGION. N. S. Amaglobeli and Yu. M. Kazarinov (Joint Inst. of Nuclear Research). Zhur. Eksptl'. i Teoret. Fiz. 34, 53-7(1958) Jan. (In Russian)

The differential cross sections for scattering of 580-Mev neutrons by protons into angles of 11, 23, and 35° (cms) were measured. A rapid rise of the cross sections with decrease of the scattering angle was observed. The results indicate that the probabilities for scattering in the "forward" and "backward" directions are approximately equal. (tr-auth)

8818

POSSIBLE EXPERIMENTS FOR INVESTIGATIONS OF INELASTIC SCATTERING OF NUCLEONS. L. M. Soroko (Joint Inst. of Nuclear Research). Zhur. Eksptl'. i Teoret. Fiz. 34, 87-96(1958) Jan.

Possible experiments for investigation of inelastic collisions of nucleons in accord with the scheme $N + N \rightarrow \pi + N + N'$ which represents the most intense process in the ~650 Mev region are considered. Some nontrivial experiments on the angular correlations of π mesons and nucleons based on the existence of azimuthal asymmetry in the emission of these particles are suggested. Analogous effects in a polarized nucleon beam are also considered. The calculations are carried out in the terms of ten inelastic transition amplitudes which are assumed to yield the main contribution to the total cross section for the process $N + N \rightarrow \pi + N + N'$ at energies of the order of 650 Mev. (tr-auth)

8819

ON THE SCATTERING OF DIRAC PARTICLES BY A SHORT-RANGE FORCE CENTER ACCORDING TO THE DAMPING THEORY. A. A. Sokolov, I. I. Guseinov, and B. K. Kerimov (Moscow State Univ.). Zhur. Eksptl'. Teoret. Fiz. 34, 110-12(1958) Jan. (In Russian)

The elastic scattering of Dirac particles by the short-range force center at rest is investigated with the help of the radiation damping theory. Formula is obtained for the effective cross section. The relation between the phase shifts of the scattering of Dirac and spinless relativistic particles is established according to damping theory. (tr-auth)

8820

APPLICATION OF THE LOW INTEGRAL EQUATION METHOD TO THE PROBLEM OF PROTON-PROTON SCATTERING. F. M. Kuni (Leningrad State Univ.). Zhur. Ekstpl'. i Teoret. Fiz. 34, 163-72(1958) Jan. (In Russian)

An integral equation of the Low type is derived and investigated in relation to the proton-proton scattering problem. The connection with the phenomenological quantum theory treatment of proton-proton scattering is established. It is shown that the total scattering cross section observed in the medium energy region can be obtained by solving the derived equation and taking into account only the most intense scattered wave $^1S_0$, providing that the contribution of states involving besides two nucleons also a number of real mesons and nucleon-antinucleons is neglected in the equation; moreover it must be assumed that the inhomogeneous term of the equation is computed in the nonrelativistic single-meson approximation. (tr-auth)

8821

THEORY OF DIFFUSE SCATTERING OF X-RAYS AND THERMAL NEUTRONS IN SOLID SOLUTIONS. III. ACCOUNT OF GEOMETRICAL DISTORTIONS OF THE LATTICE. M. A. Krivoglaz. (Inst. of Physics of Metals, Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz. 34, 204-18(1958) Jan. (In Russian)

A method for treatment of various problems connected with static distortions of crystal lattices is proposed in which the distortions are related to fluctuation waves of the composition and internal parameters. Scattering of x rays and thermal neutrons in binary solutions of arbitrary composition and with arbitrary values of the short and long range parameters is considered. Anisotropy of the crystal and its atomic structure are taken into account explicitly. The scattering intensity can be expressed in terms of the thermodynamical characteristics of the solution (or correlation parameters), elastic modulae (or interatomic interaction constants) and also in terms of parameters characterizing the concentration dependence of the cell shape and dimensions. The particular cases of ideal, dilute, almost completely ordered solutions and, also of solutions located near the critical point on the decay curve or near phase transition points of the second kind are investigated. The diffuse scattering intensity distribution in a Cu_3Au solution calculated without making use of the theoretical parameters satisfactorily agrees with the experimental distribution. (tr-auth)

8822

ON THE DEPENDENCE OF THE SECONDARY EMISSION OF NEGATIVE IONS ON THE SCATTERING ANGLE OF PRIMARY PROTONS IN COLLISIONS WITH TARGET. I. M. Mitropan and V. S. Gumenyuk (Inst. of Physics in Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz. 34, 235-6(1958) Jan. (In Russian)

Attempts were made to evaluate the changes in K coefficient in relation to the scattering angle of proton beams in collision with a target. The results showed that in the 50-kev protons from a copper or stainless steel target the number of protons at all scattering angles is larger than the number of secondary negative ions. For aluminum and beryllium targets with the scattering angle less than 30 to 40°, the number of secondary negative ions is larger than that of the scattered protons. (R.V.J.)

8823

ON NEUTRINO SCATTERING ON ELECTRONS. V. M. Shekhter (Leningrad Inst. of Physics in Tech.). Zhur. Eksptl'. i Teoret. Fiz. 34, 257-8(1958) Jan. (In Russian)

An attempt was made to show the possibility of $\nu - e$ scattering produced by the direct fermion interaction. The cross section of the scattering could prove to be of the same order or even of higher order. (R.V.J.)

Radiation Effects

8824 HW-42022

Hanford Atomic Products Operation, Richland, Wash. NEUTRON IRRADIATION OF SAPPHIRE (Al_2O_3). R. G. Wheeler. Mar. 14, 1956. 3p. Contract [W-31-109-Eng-52]. $1.80(ph OTS); $1.80(mf OTS).

A centerless-ground, 0.25-in.-diam. by 0.75-in.-long, sapphire single crystal exposed to an integrated thermal neutron flux of 2×10^{19} nvt at a temperature of 350°C (660°F) did not change its dimensions appreciably (< 0.015%). The rod appeared to break, when loaded as a simple beam, with slightly less force than was required to break a similar unirradiated rod. In a darkened room the irradiated sapphire begins to thermoluminesce noticeably

at 280°C (535°F) and most of the amber or brown coloration produced by the pile exposure is retained after annealing for 24 hr at the pile exposure temperature of 350°C (660°F). (auth)

8825 KAPL-1836

Knolls Atomic Power Lab., Schenectady, N. Y.
METALLOGRAPHY OF IRRADIATED UO_2-CONTAINING FUEL ELEMENTS. W. K. Barney and B. D. Wemple. Jan. 15, 1958. 40p. Contract W-31-109-Eng-52. $1.50 (OTS).

A description of hot laboratory metallography and techniques of operation are presented. These facilities and techniques provided a means of examining fuel elements that contain UO_2 after irradiation to high burnups. Some unusual irradiation characteristics of UO_2 were observed, and each effect is discussed. A complete explanation of the causes of such effects has not yet been obtained. (auth)

8826 WAPD-A1W(M)-366(Del. 2)

Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
SUMMARY OF BETTIS IRRADIATION DATA ON REACTOR FUEL, STRUCTURAL, AND CONTROL ROD MATERIALS. R. H. Fillnow. [July 1956]. Decl. with deletions Mar. 18, 1957. 35p. $6.30(ph OTS); $3.00(mf OTS).

The objective of irradiation studies performed at the Bettis Atomic Power Division has been to evaluate suitable nuclear fuels, control rod materials, and structural materials for use in the Pressurized Water Reactor (PWR). In general, irradiation induced physical property changes were measured on subsize specimens, exposed in reactors such as the Materials Testing Reactor (MTR) for irradiation periods that were equal to or greater than the expected reactor design exposure. Irradiation studies were made on both clad and unclad samples of fuel materials. Irradiation tests of experimental assemblies of the above materials were performed, whenever possible, under conditions that duplicated the corrosive environment and temperatures inherent to the pressurized water reactor design. The discussion of irradiation test results is divided into four separate sections: uranium base alloys, uranium dioxide, structural materials, and control rod materials. (auth)

8827 AEC-tr-3219

THE INFLUENCE OF NEUTRON IRRADIATION ON MARTENSITE TRANSORMATIONS. A. I. Zakharov and O. P. Maximova. Translated by S. J. Rothman from Doklady Akad. Nauk S.S.S.R. 114, 1195-8(1957).

The preliminary neutron irradiation of various steels significantly affected the austenite stability with respect to the martensite transformation. The change of stability was found to assume a different character in various materials. (J.E.D.)

8828

STUDY OF STRUCTURAL CHANGES PRODUCED BY NEUTRON IRRADIATION. S. T. Konobeevskii, N. F. Pravdyuk, K. P. Dubrovin, B. M. Levitskii, L. D. Panteleev, and V. M. Golyanov. Atomnaya Energiya 4, 34-44(1958) Jan. (In Russian)

Measurements were made of the electrical resistance of neutron-irradiated U−9 wt.% Mo alloy, and x-ray-diffraction and microscopic analyses were carried out to determine the structural changes in the specimen. Preliminary annealing yielded specimens with eutectic structure $\alpha + \gamma'$ of various grain sizes. The rate of diffusion under irradiation of the annealed alloy is inversely proportional to the grain area. In homogeneous specimens (γ phase) radiation induced quick alteration of properties and structure of the alloy. Observations of irradiation effects indicated a certain disorder during γ phase transition into cubic lattice. The results of the investigation are in good agreement with theory; however, the magnitudes of the thermal peak and energy were obtained as 2.5×10^{-7} cm^3 and ~2 Mev, respectively, which are smaller than the magnitudes derived previously. (tr-auth)

8829

PHOTOELECTRIC RESPONSE OF SELENIUM-TYPE PHOTOVOLTAIC CELLS TO X RAYS. R. Feinberg (Ferranti, Ltd.). Nature 181, 1057(1958) Apr. 12.

A commercially available selenium-type photovoltaic cell was irradiated with x rays produced with a commercial-type low-voltage x-ray tube with a thermionic cathode and an inclined copper target. The results indicated a linear relation between the photoelectric response and x-radiation flux irrespective of whether the flux is changed by altering the x-radiation intensity or by varying the size of the area of irradiation. The photocurrent response obtained by increasing the aperture of the lead cover over the photocell showed a reduction of radiation intensity towards the boundary of the x-ray beam. A second photocell of the same type gave a similar response, but the photocurrent values were reduced to one-third of the values obtained previously. (J.S.R.)

8830

EVIDENCE FOR THE TRAPPING OF INTERSTITIAL ATOMS IN IRRADIATED TUNGSTEN. M. W. Thompson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8) 3, 421-3(1958) Apr.

The residual resistance of tungsten specimens was measured at 4°K after reactor irradiation at −196°C. Exposure in the BEPO Reactor at Harwell for six days doubled the residual resistivity from its original value. The specimen was heated to 1500°C, which restored its resistance to the pre-irradiation value. It was then irradiated for 12 hours, which caused a resistance increase of 8.81%. It appears that increasing the irradiation time to 12 hours causes more recovery at 100°C and 200°C and that there is very little change at −40°C. The results are explained by postulating the existence of several types of traps to which interstitial atoms could become attached. Such traps could take the form of substitutional impurity atoms whose size is less than that of the tungsten atom. (A.C.)

8831

NUCLEAR RESONANCE FLUORESCENCE IN As^{75}. Franz R. Metzger (Franklin Inst., Swarthmore, Penna.). Phys. Rev. 110, 123-7(1958) Apr. 1.

When As^{75} is irradiated with the gamma rays from a gaseous source of Se^{75}, strong resonance fluorescence from the 265-kev excited state is observed. The angular distribution of the resonance radiation has the form $W(\theta) = 1 + (0.15 \pm 0.02)P_2(\cos\theta)$, indicating that the spin of the 265-kev level is larger than $\frac{1}{2}$. If one assumes a spin value of $\frac{3}{2}$, the measured self-absorption of the resonance fluorescence leads to a mean life of $(1.6 \pm 0.2) \times 10^{-11}$ second for the 265-kev transition to the ground state of As^{75}. Resonance fluorescence from the 280-kev excited state was found to be at least one order of magnitude smaller than that from the 265-kev state. From this one concludes that the mean life of the 280-kev transition is longer than 10^{-10} second. No resonance scattering from the 402-kev level was observed. On the basis of the source strength and of the geometry, the absence of an appreciable resonance effect establishes a lower limit of 10^{-10} second for the mean life of the 402-kev state, and of 7.10^{-10} second for the partial mean life of the 402-kev transition to the ground state. (auth)

Radioactivity

8832 HW-42488

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

FISSION PRODUCT HEAT GENERATION TABLES. W. H. Swift and G. L. O'Neill. Apr. 10, 1956. 57p. Contract W-31-109-Eng-52. $9.30(ph OTS); $3.60(mf OTS).

The heat generation by the radioactive decay of fission products associated with one ton of irradiated uranium was calculated by the IBM-702 computer for several irradiation histories and for cooling times of 60 to 4000 days. Only those fission products of interest in separations plant waste storage were considered. These fission products are listed along with pertinent data. (M.H.R.)

8833

A STUDY OF THE GAMMA RAYS OF Pb^{206} FROM THE DECAY OF Bi^{206} BY THE METHOD OF EXTERNAL CONVERSION IN URANIUM. Tihomir Novakov, Sölve Hultberg, and Birgit Andersson (Nobel Inst. of Physics, Stockholm). Arkiv Fysik 13, 117-28(1958).

Relative intensities of 20 gamma rays following the decay of Bi^{206} have been determined from a beta-spectrometric study of photoelectrons ejected in a 3 mg/cm^2 uranium converter. The instrumental resolution was 0.4% at high energies. A new method of analysis of the recorded photolines has been applied. Together with the earlier measurements of the internal conversion by Alburger and Pryce, the gamma ray intensities found permitted a determination of relative conversion coefficients with an accuracy of about 15%. In most cases the earlier multipolarity assignments were confirmed. (auth)

8834

GAMMA TRANSITIONS IN THE DECAY OF La^{142}. Hans Ryde and Carl Johan Herrlander (Research Inst. of National Defence, Stockholm). Arkiv Fysik 13, 177-83(1958).

The half-lives of the isotopes La^{141} and La^{142} are found to be (3.76 ± 0.10) hr and (81 ± 3) min compared with the figures 3.7 hr and 77 min given by Katcoff. The gamma rays of 0.63 Mev and 0.87 Mev found by Vanden Bosch in the decay of La^{142} are verified. Six new gamma rays with the energies 1.0, 1.8, 2.0, 2.4, 2.9 and 3.4 Mev are found by measurements with a 4-in. × 4-in. NaI(Tl) crystal. Coincidence investigations are carried out and a preliminary level scheme is given for Ce^{142}, the daughter nucleus of La^{142}. (auth)

8835

ALPHA DECAY OF Th^{227} BY THE COLLECTIVE MODEL AND NUCLEAR SPIN OF Ra^{223}. S. G. Ryzhanov. Atomnaya Energiya 4, 80-1(1958) Jan. (In Russian)

8836

ELECTRON SPECTRUM OF Pu^{240}. P. S. Samoilov. Atomnaya Energiya 4, 81-4(1958) Jan. (In Russian)

The relative conversion coefficients of γ transitions in U^{236} at L and M subshell levels were measured to find the multipole γ emission and to determine the characteristics of the nuclear levels. (R.V.J.)

8837

SPECTRA OF INTERNAL CONVERSION ELECTRONS OF THE LONG-LIVED ISOTOPES Eu^{152} and Eu^{154}. B. V. Bobykin and K. M. Novik (Leningrad Physico-Technical Inst.). Izvest. Akad. Nauk S.S.S.R. Ser. Fiz. 21, No. 12, 1556-72(1957) Dec. (In Russian)

Radioactivity of Eu^{152} and Eu^{154} with half lives of 13 and 16 years, respectively, and products of their decay Sm^{152}, Gd^{152}, Gd^{154}, and possibly Sm^{154} were investigated. Improved tables are presented of the identification and relative intensities of conversion lines in Eu^{152} and Eu^{154} decay. Comparisons were made of experimental and theoretical relations for conversion coefficients. Decay schemes for Eu^{152} and Eu^{154} and absolute magnitudes of conversion coefficients of the K shell developed on the relative intensities of K lines and relative intensities of γ rays are included. (R.V.J.)

8838

INVESTIGATIONS OF Ce^{144} DECAY USING $\beta-\gamma$ COINCIDENCES. V. P. Parfenova, N. V. Forfontov, and V. S. Shpinel. Izvest. Akad. Nauk S.S.S.R. Ser. Fiz. 21, No. 12, 1601-6(1957) Dec. (In Russian)

The decay scheme of $Ce^{144}-Pr^{144}$ was studied. Results indicate that β spectra coincidences with three different areas of γ spectra are quite complex. In basic transition into Pr^{144} spectrum β_4 falls out. Observations of $\beta-\gamma$ cascades point out that β transitions of $\beta_3(E_{\beta\ max}$ = 230 kev) and $\beta_2(E_{\beta\ max}$ = 175 kev) excite Pr^{144} levels with the energy of 80 and 134 kev, respectively. The spectrum $\beta_1(E_{\beta\ max}$ = 130 kev) was observed on all rectified graphs. The β spectrum softer than 175 kev indicates the evidence of Pr^{144} excitation level located above 134 kev level. (R.V.J.)

8839

APPLICATION OF THE KURIE PLOT TO THE STANDARDIZATION OF PURE BETA-EMITTERS. R. A. Lloyd (National Physical Lab., Teddington, Middlesex, Eng.). Nature 181, 1055-6(1958) Apr. 12.

The standardization of pure beta emitters may be possible by extrapolating to zero the straight Kurie plot which should be obtained for a single allowed beta transition. The relation between the slope of the Kurie plot and the absolute disintegration rate of a radioactive source is shown, and the method of application to 4π counting is described. (J.S.R.)

8840

NATURAL AIRBORNE RADIOACTIVITY AT KJELLER, NORWAY. S. H. Small, A. Lillegraven, and P. B. Storebø (Norwegian Defence Research Establishment, Kjeller, Norway). Nature 181, 1197-8(1958) Apr. 26.

Airborne concentrations of radon and thoron daughters have been investigated by monitoring the beta activity of a small asbestos filter through which air is drawn at a rate of about 25 l/min. During the last four months of 1957 radon concentrations have varied between 30 and 1,100 × 10^{-18} c/cm^3 of air. Rapid increases to the highest values were noticed under atmospheric conditions of low inversion and temperature. This was explained by the possible trapping of considerable radon exhalation in the cooled air which tends to follow the natural water flow from the higher ground around Kjeller. (J.S.R.)

8841

FIRST-FORBIDDEN TRANSITIONS IN PARITY-NONCONSERVING BETA DECAY. Masato Morita and Reiko Saito Morita (Columbia Univ., New York). Phys. Rev. 109, 2048-58(1958) Mar. 15.

Previous work on beta-gamma directional correlations is extended to phenomena of nonconservation of parity in beta decay. The parameters, $b_{LL'}^{(n)}$, which express the beta-ray angular distributions, are given for first-forbidden transitions of a general interaction, STPVA, where we assume no interferences between STP and VA. All of the possible interferences among the six nuclear matrix elements, $\mathcal{M}(\beta\sigma\cdot\mathbf{r})$, $\mathcal{M}(\beta\gamma_5)$, $\mathcal{M}(\beta\mathbf{r})$, $\mathcal{M}(\beta\alpha)$, $\mathcal{M}(\beta\sigma\times\mathbf{r})$, and $\mathcal{M}(B_{ij}^{\beta})$ for STP (and the corresponding matrix elements for VA) are taken into account. By using these $b_{LL'}^{(n)}$'s, it is easy to express the correction factor of beta spectra, the beta-ray angular distributions from oriented nuclei, and the angular correlations between beta rays and circularly polarized gamma rays from unoriented nuclei in double and triple cascade transitions. The experimental

data on the beta decays of Sb^{124} and Au^{198} are analyzed. (auth)

8842

HIGHER ORDER EFFECTS IN THE β DECAY OF P^{32}. Icko Iben, Jr. (Univ. of Illinois, Urbana). Phys. Rev. 109, 2059-62(1958) Mar. 15.

The assumption is made that the β decay of P^{32} is Δl-forbidden. The effect of interferences between second forbidden matrix elements and the (Δl-reduced) allowed elements on the decay probability is presented. By using simple shell-model wave functions, an order of magnitude estimate of nuclear matrix elements is obtained. The resulting deviation of the energy spectrum from the allowed shape compares favorably with the experimental points of Porter, Wagner, and Freedman. (auth)

8843

NUCLEAR MATRIX ELEMENT RELATIONS IN THE FERMI THEORY OF BETA DECAY. Tino Ahrens (Lockheed Aircraft Corp., Marietta, Ga.). Progr. Theoret. Phys. (Kyoto) 18, 331-44(1957) Oct.

The purpose of the paper is largely consolidatory. A common basis is provided for the formal relations between forbidden nuclear matrix elements. It is shown how numerical estimates of the coefficients of proportionality can subsequently be made upon introducing on the one hand less and on the other hand more detailed nuclear force characteristics. Coarse structure correction factors are derived differing from similar ones appearing in the literature. Finally, it is indicated how theoretical nuclear matrix element ratios may serve in the interpretation of beta spectra. (auth)

8844

NEUTRON EMISSION FROM A SHORT-LIVED RADON ACTIVE DEPOSIT. A. V. Kogan (Leningrad Physico-Tech. Inst., Academy of Sciences, USSR). Soviet Phys. (Doklady) 1, 372-4(1956) May-June.

During an investigation of gamma radiation from radon in ampoules of pure heavy metals, a weak neutron background was detected. The neutron activity was only slightly dependent on the material of the ampoule and comprised about 3 n/sec per millicurie of radon. A detailed study of the mechanism of the neutron emission was made. The results led to the assumption that the principal process which produces the neutron activity of a short-lived radon deposit is neutron emission by excited RaD (Pa^{210}) nuclei formed by the beta decay of RaC″ (Tl^{210}). (J.S.R.)

8845

FINE STRUCTURE IN THE ALPHA DECAY OF ODD NUCLEI. V. G. Nosov. Soviet Phys. JETP. 6, 176-9(1958) Jan.

The excitation of rotational levels in the α decay of nonspherical odd nuclei is considered. (auth)

8846

EFFECT ON ATMOSPHERIC ELECTRICITY OF ARTIFICIAL RADIOACTIVITY. H. Israel (Aus dem Meteorologischen Observatorium Aachen des Deutschen Wetterdienstes). Z. Physik 151, 35-45(1958). (In German)

For proof of the question of whether the artificial radioactivity in the atmosphere following atomic bomb explosions could influence the atmospheric electricity ratio, the ionizing effect of fission products was compared with that of the natural ionizers in the atmosphere. It is shown that the fission products suspended in the air can not possibly modify the atmospheric electricity ratio. At sea level, however, effects are possible on the atmospheric electric field and the atmospheric conductivity at high fall-outs, but about all at dry fall-out. Of a permanent change of the atmospheric electrical ratios by "radioactive poisoning" of the air, as has been recently asserted, there can be no discussion at present. (tr-auth)

8847

LOW ENERGY γ-TRANSITIONS IN Tm^{169}. K. N. Shlyagin and P. S. Samoilov (Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. 34, 29-32(1958) Jan. (In Russian)

A magnetic β spectrometer was employed to measure the electron spectrum of Yb^{169} in the 3 to 70 kev energy range. The relative intensities of the detected electron conversion lines are for the 8.32 kev γ-transition, $M_I : M_{II} : M_{III} : M_{IV} = 1 : 0.42 : 0.48 : 0.10$; for the 20.65 kev γ-transition, $L_I : L_{II} : L_{III} = 1.0 : 0.14 : 0.03$; $M_I : M_{II-V} = 1 : 0.2$. The type of the 8.32 kev transition is found to be M1 + E2 (<3%), and that of the 20.65 kev transition, M1. (tr-auth)

Rare Earths and Rare-earth Compounds

Refer also to abstract 8497.

8848 AFOSR-TN-58-292

Horizons, Inc., Cleveland.

MAGNETIC SUSCEPTIBILITIES OF PRASEODYMIUM AND TERBIUM OXIDES. Technical Note No. 4. R. C. Vickery and A. Ruben. May 1, 1958. 15p. Contract AF18(603)-96. (AD-154197).

The magnetic susceptibilities of the three oxides of praseodymium—Pr_2O_3, Pr_6O_{11}, and PrO_2—and the three oxides of terbium—Tb_2O_3, Tb_4O_7, and Tb_6O_{11}—were measured over a range of temperature. The magnetic moments for the praseodymium oxides are 3.55, 2.77, and 2.51 Bohr magnetons, respectively, while those of the terbium oxides are 9.62, 8.70, and 8.49 Bohr magnetons, respectively. These values are based on temperature-susceptibility data below 300°K and indicate adherence to the Curie-Weiss law. They are in good agreement with theoretical values for the proposed formula. Above 300°K the slope for T vs. $1/X_M$ changes abruptly and would give considerably lower moments if extrapolated. (auth)

8849

ELECTRON-CAPTURE DECAY ON GADOLINIUM-151. Virginia S. Shirley and John O. Rasmussen (Univ. of California, Berkeley). Phys. Rev. 109, 2092-7(1958) Mar. 15.

The photon and conversion electron spectra following electron-capture decay of Gd^{151} were studied. Transitions of 21.59 (M1), 153.7, 175.0 (M2), 243.8 (E1), and 308.4 kev seen in these spectra and a very weak transition of 155 ± 5 kev seen in coincidence with the 153.7-kev transition were assigned to the decay of Gd^{151}. Relative photon, conversion-electron, and transition intensities were determined for some of the transitions, and coincidence measurements were made at resolving times of 4 and 40 microseconds. The 175.0-kev transition was observed to depopulate a metastable state with a half-life of 58 ± 10 microseconds. A level scheme is proposed for Eu^{151} including the levels populated by Coulomb excitation, β^- decay of Sm^{151}, and electron-capture decay of Gd^{151}. (auth)

8850

MAGNETIC AND CRYSTALLOGRAPHIC PROPERTIES OF SUBSTITUTED YTTRIUM—IRON GARNET, $3Y_2O_3 \cdot \chi M_2O_3 \cdot (5-\chi)Fe_2O_3$. M. A. Gilleo and S. Geller (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Rev. 110, 73-8(1958) Apr. 1.

A solid solution of yttrium—iron garnet with yttrium—gallium or yttrium—aluminum garnet is formed over the entire range of composition; the lattice constant variation is nearly linear. The trivalent ions, Sc^{3+}, In^{3+}, and Cr^{3+},

may be substituted for Fe^{3+} to a limited extent. Substitution proceeds on a steric basis for nonmagnetic ions: those smaller than Fe^{3+}, namely Al^{3+} and Ga^{3+}, preferentially occupy the smaller, tetrahedrally coordinated sites, 24(d); larger ions, In^{3+} and Sc^{3+}, preferentially occupy larger, octahedrally coordinated sites, 16(a). The Cr^{3+} ion, though smaller than Fe^{3+}, preferentially occupies the octahedral site, presumably because of its electronic configuration. The magnetic moment initially rises with octahedral substitution of nonmagnetic ions and falls with tetrahedral substitution because the moment corresponds to the difference in the moments of the Fe^{3+} ions in the two octahedral sites and the three tetrahedral sites per formula unit, $Y_3Fe_2(FeO_4)_3$. The Curie temperature is decreased by the substitution of nonmagnetic ions for iron on account of the decrease in the number of $Fe^{3+}-O^{2-}-Fe^{3+}$ interactions. (auth)

8851

ELECTRON NUCLEAR DOUBLE RESONANCE OF NEODYMIUM. Donald Halford, Clyde A. Hutchison, Jr., and Peter M. Llewellyn (Univ. of Chicago). Phys. Rev. 110, 284-6(1958) Apr. 1.

The method of electron nuclear double resonance has recently been employed by Feher for investigation of some solid-state problems. In this letter the application of this method for an investigation of Nd^{3+} in $LaCl_3$ crystals is discussed. A tabulation is made of the frequencies so far observed at which the second resonance for Nd^{145} occurs when the c axis is parallel to H. The remainder of the measurements are in progress. (A.C.)

8852

ON THE MAGNETIC PROPERTIES OF CUBIC CERIUM. Tsuyoshi Murao and Takeo Matsubara (Hokkaido Univ., Sapporo and Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 18, 215-22(1957) Sept.

In terms of the level splitting of the electronic state $4f^1(^2F_{\frac{5}{2}})$ due to the crystalline and exchange field, the magnetic susceptibility and specific heat of cubic cerium are calculated theoretically and compared with experiments. The intensity of the crystalline field is also estimated using a simplified model of the metallic state. The agreement between theory and observation is fairly good. (auth)

8853

TWO TYPES OF RARE-EARTH LUMINESCENCE SPECTRA IN SYNTHETIC FLUORITE CYRSTALS. I. V. Stepanov and P. P. Feofilov. Soviet Phys. (Doklady) 1, 350-3(1956) May-June.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 787.

Shielding

Refer also to abstract 8587.

8854 CF-58-1-41

Oak Ridge National Lab., Tenn.

STRATIFIED SLAB GAMMA-RAY DOSE-RATE BUILDUP FACTORS FOR LEAD AND WATER SHIELDS. L. A. Bowman and D. K. Trubey. Jan. 16, 1958. 10p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

The ORACLE Monte Carlo code for the calculation of the penetration of gamma rays through stratified slabs was used to calculate a total of 512 problems for eight different lead and water configurations. The energy of the incident radiation, the angle of incidence, the thickness of the shield, and the percentage of lead preceding or following water were varied. The source was assumed to be a monodirectional beam with energies of 1, 3, 6, and 10 Mev. The incident angles chosen were those which would give slant thicknesses of 1, 2, 3, and 4 times the normal thickness. The infinite slabs had finite normal thicknesses of 1, 2, 4, and 6 mean free paths. The results obtained included the dose rate and energy flux throughout the slab and at the rear; dose-rate buildup factors; the heat deposited throughout the slab; and the energy and angular distribution reflected from and transmitted through the slab. Only the buildup factors at the rear of the slabs for normal incidence are considered in this report. (auth)

8855 ORNL-436(Del.)

Oak Ridge National Lab., Tenn.

A CRITICAL REVIEW OF ORNL SHIELD MEASUREMENTS: NEUTRON ATTENUATION. H. P. Sleeper, Jr. Dec. 21, 1949. Decl. with deletions Feb. 21, 1957. 47p. Contract W-7405-eng-26. $7.80(ph OTS); $3.30(mf OTS).

The purpose of this report is to summarize the neutron data for the most valuable tests of uniform shield where both the shield attenuation and composition are considered well known. Also the results of heavy metal differential neutron measurements are reported, even though the composition of the neutron analyzer is not well known. In these experiments, measurements were made in a uniform "analyzer" shield with and without a heavy metal front slab. The difference is an index of the fast neutron shielding characteristics of the metal. (auth)

Spectroscopy

8856 LA-2151

Los Alamos Scientific Lab., N. Mex.

A PORTABLE HIGH-RESOLUTION GRATING-ECHELLE SPECTROGRAPH. C. Petty and G. H. Dieke. Aug. 14, 1957. 41p. Contract W-7405-eng-36. $1.25(OTS).

A grating-echelle spectrograph is described similar to the Wadsworth-echelle spectrograph designed by Harrison. In this design particular attention was paid to making the instrument portable. The spectrograph is thus an instrument of high resolution and dispersion suitable for field use. The spectrum between 2000 and 9500 A is photographed on three 16-in.-long plates, with a dispersion varying between 0.18 to 0.89 A/mm corresponding to the 1090th to 229th order of the echelle. With existing echelles the performance is limited by the echelle properties. Detailed data are given on the test of two echelles. (auth)

8857 AEC-tr-3203

IMPROVED METHODS OF X-RAY SPECTROSCOPY. K. I. Narbutt. Translated from Vestnik Akad. Nauk S.S.S.R. 27, 108-10(1957). 6p.

This paper was previously abstracted from the original language and appears in Nuclear Science Abstracts, Vol. 11, as abstract No. 10789. (J.E.D.)

8858

SOME CALCULATIONS ON A TIME-OF-FLIGHT β-SPECTROMETER WITH TROCHOIDAL ORBITS. K. G. Malmfors. Arkiv Fysik 13, 237-45(1958).

Magnetic β spectrometers are characterized by two essential properties, the resolution and the transmission. In all such spectrometers improved resolution can be obtained at the expense of the transmission and vice versa. As a rule 1% resolution cannot be combined with more than one or possibly a few per cent transmission. A spectrum is measured point for point by varying the magnetic field, except in the case of photographic recording as in the semicircular spectrometer. In scintillation spectrometers conditions are somewhat different. The detection probability, corresponding to the transmission, can be

very high, but on the other hand, the energy resolution by means of pulse height analysis cannot be made better than 5 to 10%, a limit which is mainly set by the present state of the development of photomultipliers. By using a multichannel analyzer, a whole scintillation spectrum, or a certain part of it, can be measured simultaneously, which is a great advantage especially in the case of a rapidly decaying source or in the study of radiation induced by an accelerator. It seems possible to combine some of the features of these complementary types of spectrometer by introducing the time-of-flight technique into β spectroscopy. The velocity of a β particle is close to the velocity of light, which means that a direct determination of the particle velocity will give very poor information about the energy. By introducing the trochoidal motion in an inhomogeneous magnetic field, this difficulty is overcome because in this case the flight path is multiplied by a large factor which depends on the particle energy. It is the purpose of this paper to discuss in detail the expected properties of such a spectrometer. (auth)

8859

PRELIMINARY EXPERIMENTS ON TIME-OF-FLIGHT β-SPECTROSCOPY. K. G. Malmfors and A. Nilsson (Nobel Inst. of Physics, Stockholm). Arkiv Fysik 13, 247-50(1958).

The properties of a provisional time-of-flight spectrometer are investigated and compared to theory. The agreement with theory is shown to be generally good. (auth)

8860

PRECISION MEASUREMENT OF THE L X-RAY SPECTRA OF URANIUM AND PLUTONIUM. John J. Merrill and Jesse W. M. DuMond (California Inst. of Tech., Pasadena). Phys. Rev. 110, 79-84(1958) Apr. 1.

Twenty uranium L x-ray transitions have been measured using a commercial, sealed off, uranium target x-ray tube. Twelve plutonium L x-ray transitions have been measured in conventional x-ray fluorescence from a 5.86-g sample. All lines were measured with high precision using the two-crystal spectrometer, and corrected for the effects of temperature on the grating space of calcite, the effects of vertical divergence, and the effects of crystal diffraction pattern asymmetry. The wavelengths corresponding to these transitions are given in terms of the x-unit (where the latter is so defined that the wavelength of the Mo $K_{\alpha 1}$ line is 707.8490 x-units) with relative errors of less than 15 ppm (parts per million) in the case of U, and less than 30 ppm in the case of Pu. (auth)

8861

COMPTON SPECTROMETER USING SUPERPOSITION OF PULSES. V. R. Burmistrov and Yu. A. Kazanskiy. Pribory i Tek. Ekspt. No. 2, 26-9(1957).

After a brief discussion of the operation of the Compton spectrometer using two scintillation crystals, a description is given of a method which permits a substantial increase of the efficiency of the spectrometer without deterioration in its resolving characteristics. A central and two side crystals are used. The increase in efficiency is obtained by increasing the solid angle of resolution by combination of the pulses from all three crystals. The efficiency of the spectrometer was 1.9%, whereas the efficiency of the normal Compton spectrometer is 0.068%. (J.S.R.)

8862

ISOTOPIC SHIFT IN THE SPECTRUM OF He II. P. S. Kireev (M. V. Lomonosov Moscow State Univ.). Soviet Phys. (Doklady) 1, 316(1956) May-June.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 1384.

Theoretical Physics

8863 AECU-3677

RAND Corp., Santa Monica, Calif.

RELATIVISTIC OSCILLATOR STRENGTHS. Fred Zachariasen. Jan. 15, 1958. 13p. Contract AT(29-1)-1477. (RM-2092(AEC); AD-150673). $3.30(ph OTS); $2.40(mf OTS).

The calculation of radiative transition rates between eigenstates of a relativistic electron moving in a central potential is considered. The general formula is derived for arbitrary photon multipole and parity, without neglect of retardation. The reduction to a single integral over the Dirac radial wave functions is made for electric multipole moments. A further simplification gives the explicit formula for electric dipole transitions. (auth)

8864

APPROACH TO THE QUANTUM MECHANICAL MANY-BODY PROBLEM WITH STRONG TWO-PARTICLE INTERACTION. I. Evert Andersén and Ulf Uhlhorn (Inst. of Theoretical Physics, Stockholm). Arkiv Fysik 13, 165-76(1958).

The methods discussed have been developed with the nuclear many-body problem, formulated as a classical quantum mechanical many-body problem with only two-particle interaction and without any assumption of the origin of nuclear forces in mind. Two approaches characterized by different wave functions are discussed, and the general equations for the determination of "best two-particle orbitals" are derived. The problem of the two interacting particles are examined in a common potential. This common potential is chosen as an oscillator. (W.D.M.)

8865

PERTURBATION EXPANSIONS IN THE FORMAL THEORY OF SCATTERING. James E. Young (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 109, 2141-4(1958) Mar. 15.

Expressions are derived for the matrix elements of the transition operator relevant to that situation in which so-called surface potentials are to be taken into account as perturbations upon the usual core potentials. Some comparison is made of the class of approximations which appear in the literature and the restrictions upon their generality. (auth)

8866

BOUNDS ON SCATTERING PHASE SHIFTS. I. Larry Spruch and Martin Kelly (New York Univ.). Phys. Rev. 109, 2144-8(1958) Mar. 15.

This paper investigates the method of obtaining bounds on scattering phases developed by T. Kato. Circumstances under which it is possible to obtain rather good bounds on the phase shifts by simple procedures are investigated. Useful formulas and techniques are presented and illustrative examples given. (auth)

8867

BOUNDS ON SCATTERING PHASE SHIFTS. II. Larry Spruch (New York Univ. and Cavendish Lab., Cambridge Univ., Eng.). Phys. Rev. 109, 2149-59(1958) Mar. 15.

Though the Kato technique for obtaining bounds on the cotangent of the scattering phase shift, $\bar{\eta}_L$, is extremely general and powerful, an integration must be performed which can be quite troublesome, and some preliminary, albeit crude, information about $\bar{\eta}_L$ is required before the method can be applied. It is shown here that in the evaluation of the upper bound on $\cot\bar{\eta}_L$, the integration can often be eliminated without any significant increase in the value of the upper bound. It is also shown that the Kato formalism is often useful even when one does not possess the necessary a priori knowledge of $\bar{\eta}_L$; under realistic

specified conditions, a bound can be obtained on $\bar{\eta}_L$ even when a bound cannot be obtained on $\cot\bar{\eta}_L$. Further, a procedure analogous to iteration is introduced whereby this bound on $\bar{\eta}_L$ can be improved. The bound on $\bar{\eta}_L$ is of interest in its own right. It may also help to provide the preliminary information necessary for the determination of bounds on $\cot\bar{\eta}_L$. It is shown that if the potential V(r) is nonpositive, $\bar{\eta}_{L+}$ and/or $|\bar{\eta}_{L-}|$ must be larger than the Born phase shift η_{BL+}, where $\bar{\eta}_{L\pm}$ are the phase shifts associated with $\pm V$; if $V(r) \leq 0$ and if $|\bar{\eta}_{L\pm}| < \pi$, then $\cot\bar{\eta}_{L+} - \cot\bar{\eta}_{L-} \leq 2\cot\eta_{BL+}$. A slight generalization of the Schwinger integral variational principle gives similar results for phases related to $V \pm U$. (auth)

8868

POSSIBLE MODEL FOR STRONG INTERACTIONS. Saul Barshay (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 109, 2160-2(1958) Mar. 15.

A model is considered for the strong interactions of pions, K mesons, nucleons, and hyperons. A system of interactions is postulated and several features of the experimental situation are discussed from the new viewpoint. No restrictions are placed upon the coupling parameters involved other than that they characterize a system of strongly interacting particles. (auth)

8869

DISCRETE STATES FOR SINGULAR POTENTIAL PROBLEMS. F. L. Scarf (Univ. of Washington, Seattle). Phys. Rev. 109, 2170-6(1958) Mar. 15.

The solutions of the quantum mechanical wave equations for singular potentials are re-examined. It is shown that a set of orthonormal wave functions with complex energy eigenvalues ($E_n = W_n \pm \frac{1}{2}i\Gamma_n$) is obtained if certain natural analyticity requirements are imposed on the form of the potentials. In general, the result is interpreted in the following way: W_n is the most probable position of the energy level for various types of cutoff and Γ_n is a measure of the probable error. (auth)

8870

PROOF OF DISPERSION RELATIONS IN QUANTIZED FIELD THEORIES. H. J. Bremermann, R. Oehme, and J. G. Taylor (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. 109, 2178-90(1958) Mar. 15.

The problem of deriving dispersion formulas is reduced to that of the analytic continuation of all functions which are regular in certain domains in the space of several complex variables. The dispersion relations for pion-nucleon scattering are proven for momentum transfer in the center-of-mass system which are smaller than $2\sqrt{2}M_\pi$. This limit can be improved by further analytic continuation. By using causality and spectral conditions the dispersion formulas for forward nucleon-nucleon scattering could be derived only under the unphysical condition $M_\pi > (\sqrt{2}-1)M_N$. We cannot exclude the possibility that this restriction is weakened by taking into account all symmetry properties of the complete four-body Green's function. The situation is similar for the representation of the meson-nucleon vertex function taken on the mass shell of the nucleons. In this case an example of R. Jost shows that the validity of the dispersion formula cannot be guaranteed on the basis of causality, spectrum, and symmetry properties. (auth)

8871

DIRECT FORMULATION OF CAUSALITY REQUIREMENTS ON THE S OPERATOR. I. E. Segal (Univ. of Chicago). Phys. Rev. 109, 2191-8(1958) Mar. 15.

From a relatively operational causality assumption roughly to the effect that outgoing particles can be observed only when there have previously been incoming particles, dispersion relations for forward scattering of a scalar particle may be derived, in a manner that extends in principle to all types of scattering. (auth)

8872

FORMULATION OF QUANTUM MECHANICS BASED ON THE QUASI-PROBABILITY DISTRIBUTION INDUCED ON PHASE SPACE. George A. Baker, Jr. (Univ. of California, Berkeley). Phys. Rev. 109, 2198-2206(1958) Mar. 15.

A formulation of quantum mechanics is postulated which is based solely on a quasi-probability function on the classical phase space. It is then shown that this formulation is equivalent to the standard formulation, and that the quasi-probability function is exactly analogous to the density matrix of Dirac and von Neumann. The theory of measurement in this formulation is investigated, and the following remarkable results are derived. As is well known, the correspondence between classical functions of both the position and conjugate momentum and quantum mechanical operators is ambiguous because of noncommutativity. It is shown that the solution of this correspondence problem is completely equivalent to the solution of the eigenvalue problem. This result enables one to give a constructive method to compute eigenvalues and eigenfunctions. (auth)

8873

MASS DIFFERENCE $T-He^3$ AND THE MASS OF THE NEUTRINO. Lewis Friedman and Lincoln G. Smith (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 109, 2214-15(1958) Mar. 15.

The rest mass of the neutrino has been estimated to be between zero and 1 kev from analysis of the shape of the tritium beta spectrum near its end point. These estimates are made on a theory of the nature of the beta-decay process. A purely empirical determination of this rest mass may be obtained from the difference between the mass difference $T-He^3$ and beta end-point energy. (A.C.)

8874

ANNIHILATION METHOD FOR MEASURING TRANSVERSE POLARIZATION OF ENERGETIC POSITRONS. Lorne A. Page (Inst. of Physics, Uppsala). Phys. Rev. 109, 2215-17 (1958) Mar. 15.

Recently several methods have been successfully used to measure longitudinal polarization of energetic positrons; however, few real possibilities appear to be known for analysis of the transverse polarization. An annihilation method for measuring transverse polarization of energetic positrons is discussed. (A.C.)

8875

UNIVERSAL FERMI INTERACTION. R. E. Behrends (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 109, 2217-18(1958) Mar. 15.

Experimental evidence seems to indicate that the Fermi coupling for beta decay may be of the form V−A, which in form and strength is also consistent with the muon decay data. A theoretical argument for such a coupling is proposed. (A.C.)

8876

DISPERSION RELATIONS FOR COMPTON SCATTERING. R. W. Prange (Univ. of Chicago). Phys. Rev. 110, 240-52(1958) Apr. 1.

The perturbation formulas for Compton scattering with radiative corrections are written as dispersion relations. The purpose is to learn something about (1) the number of subtractions that are needed in the relations, (2) the analytic continuation of the scattering amplitude into the unphysical region, and (3) the role of the infrared divergence. It is found that one subtraction is needed to obtain dispersion relations but that these equations still depend on the fictitious mass of the photon. To obtain relations which contain only physical quantities another subtraction is

made. It is suggested that the imaginary part of the amplitude has fewer singularities than the amplitude itself, and consequently may, in some cases, be continued by means of the phase-shift expansion. Finally, it is shown that the Born approximation is equivalent to the so-called one-electron-intermediate-state contribution to the dispersion relation. (auth)

8877

SCATTERING OF LIGHT BY PROTONS. W. J. Karzas (RAND Corp., Santa Monica, Calif.), W. K. R. Watson (Univ. of California, Berkeley), and F. Zachariasen (Univ. of California, Berkeley and RAND Corp., Santa Monica, Calif.). Phys. Rev. 110, 253-60(1958) Apr. 1.

Within the framework of the Chew-Low-Wick development an analysis of the scattering of photons from a nucleon is carried out. It is shown that an exact relationship exists between the Compton effect amplitude and the experimental meson-nucleon scattering phase shifts for all multipoles except magnetic dipole and electric quadrupole provided that effects arising from currents inside the nucleon source (i.e., line currents) are slowly varying functions of photon energy. That part of the magnetic dipole scattering which can be described in terms of the isotopic vector part of the anomalous magnetic moments of the nucleon is also treated exactly. The cross section for the Compton process is evaluated on the basis of the electric and magnetic dipole contributions only, since a nonrecoil theory is clearly expected to be poor for photon energies greater than 300 Mev. Fairly good agreement with experiment is achieved. (auth)

8878

IDENTICAL SCATTERING FROM CAUSAL AND NON-CAUSAL INTERACTIONS. S. Gasiorowicz and M. A. Ruderman (Univ. of Copenhagen). Phys. Rev. 110, 261-4 (1958) Apr. 1.

The scattering amplitude is explicitly written in terms of the commutator of the field operators far from the scatterer only, so that "microscopic causality" cannot be inferred from the scattering amplitude alone. It is shown how to construct a nonlocal Hamiltonian for a Klein-Gordon particle which gives exactly the same scattering at all angles and momenta as that from an arbitrary local scalar potential, but differs in that the commutator of the field operators does not vanish everywhere outside the light cone. (auth)

8879

ENERGY SHIFTS IN THE FEYNMAN FORMALISM. Leonard S. Rodberg (RIAS, Inc., Baltimore). Phys. Rev. 110, 277-8(1958) Apr. 1.

The relation between the S matrix and the energy-level shift is demonstrated in a form which permits the use of the Feynman methods of calculation. It is also shown that vacuum fluctuations and "unlinked clusters" do not contribute to the energy of a physical system. (auth)

8880

CHIRALITY OF TENSORS AND PARITY-NONCONSERVING INTERACTIONS. Yasutaka Tanikawa (Inst. for Advanced Study, Princeton, N. J.) and Satosi Watanabe (IBM Research Lab., Ossining, N. Y.). Phys. Rev. 110, 289-90 (1958) Apr. 1.

In this letter it is shown that there necessarily exist two independent chirality operators, X, Y, in tensor calculus, and that any Lagrangian has to be invariant under the combined transformation X·Y·P, where P is the parity operator. (A.C.)

8881

A THEORY OF ELEMENTARY PARTICLES. Takao Tati (Kanazawa Univ., Japan). Progr. Theoret. Phys. (Kyoto) 18, 235-46(1957) Sept.

A theory of elementary particles formulated without using space-time co-ordinates is given. The causality principle in the theory is given by the relation of the results of two measurements in the ordered observation (O_1, O_2). The causality principle contains an undetermined constant (a four-vector) $C(O_1, O_2)$. The space-time is derived when the undetermined constants in the ordered observation (O_1, O_2, O_3 . . .) are given values by the law of probability. The field theory is valid only for "the local ideal system" which has no fluctuation of space-time. The limits of validity of the theory of relativity and the quantum mechanics based on Schrödinger equation are given in view of the theory. The difficulty of nonintegrability of the nonlocal field theories which aim at avoiding the divergence difficulty disappears into the fluctuation of space-time in the theory. A view is mentioned that the spatial extension of the proton core found in the high energy electron scattering is possibly an observed effect of the fluctuation of the "space-time of the system" in the theory. (auth)

8882

THE PARITY CONSERVATION AND THE STRENGTH OF THE INTERACTION OF ELEMENTARY PARTICLES. Sho Tanaka (Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto) 18, 295-313(1957) Sept.

In addition to the usual space and time, the two degrees of freedom which may be concerned in the mass of elementary particles are introduced. Based on the fundamental postulate with respect to the symmetry in the above new degrees of freedom, as well as the invariance under the proper Lorentz-transformation, a theory is formulated, and the violation law of the parity conservation and of the invariance under the particle conjugation in connection with the strength of interactions is approved. It is shown that the theory has a close relation to the two-component neutrino theory proposed by Lee and Yang and also to Landau's theory. (auth)

8883

ON THE CUT-OFF THEORY IN QUANTUM FIELD THEORY. Seiya Aramaki (Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto) 18, 320-2(1957) Sept.

For the investigation of the problem of internal consistency of current quantum field theory the cut-off method is usually adopted. Among others, the cut-off method proposed by Gell-Mann and Low has very frequently been used and was very useful for finding the high-energy behavior of quantum field theory. However, no one to this date has ever made certain whether this cut-off method was really a consistent cut-off theory, or whether it reduced to the original divergent theory in the nomenclature of Gell-Mann and Low when the cut-off momentum was made to go to infinity. In this note this problem in Lee's model and up to the fourth-order perturbation approximations in quantum electrodynamics is considered. (A.C.)

8884

CLUSTER DEVELOPMENT METHOD IN THE QUANTUM MECHANICS OF MANY PARTICLE SYSTEM. II. Fumiaki Iwamoto (Univ. of Tokyo) and Masami Yamada (National Research Council, Washington). Progr. Theoret. Phys. (Kyoto) 18, 345-56(1957) Oct.

The cluster development method formulated in the first paper is applied to the discussion on the saturation of nuclear forces. Serber-type two-body forces with hard cores are assumed, in which central potentials are assumed to be spin independent. The potential depth and range are determined from the scattering length and the effective range in the spin singlet state, and the hard core radius is taken as $D = 0.6 \times 10^{-13}$ cm. The Coulomb forces are neglected. The usual variational method is used with a simple trial correlation function. By using the one- and

two-nucleon clusters only, the energy minimum per nucleon is found to be −5.2 Mev at $r_0 = 1.1 \times 10^{-13}$ cm. At this minimum point the three-nucleon cluster terms are evaluated. They are one order of magnitude smaller than the leading term, and the convergence of the development seems to be fairly good. It is seen that the effective potential for the single particle motion in the nuclear matter is much weakened after separating the short range correlations between nucleons. (auth)

8885

STATIC MODEL IN THE MESON THEORY. Masao Sugawara (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto) 18, 383-95(1957) Oct.

A non-linear static model is constructed from the relativistic γ_5-theory, by approaching the static limit after a canonical transformation is applied to the original γ_5-Hamiltonian, with no perturbation expansion used. It is then proven that the same analysis as due to Chew and Drell et al. of P- and S-wave pion-nucleon scattering can be applied even for the general non-linear static model obtained, as far as the one-meson approximation is done. In our model, however, various renormalized coupling constants are uniquely defined in terms of the unrenormalized ps−ps coupling constant. Furthermore, their numerical values depend in general on the types of the process concerned; the renormalized P-wave coupling constant effective in pion-nucleon scattering is different from one determining threshold gamma-pion production. Rough numerical estimations of these renormalized coupling constants are done for two transformations found by Dyson and by Foldy. The results seem qualitatively satisfactory, including a strong meson-pair term damping, though a definite statement is not permitted yet. (auth)

8886

IONIZATION LOSS NEAR THE ORIGIN OF AN ELECTRON PAIR OF VERY HIGH ENERGY. Iwao Mito and Hiroshi Ezawa (Univ. of Tokyo). Progr. Theoret. Phys. (Kyoto) 18, 437-47(1957) Oct.

Ionization loss of negatron-positron pair is calculated as a function of their distance. This result will be useful to measure the energy of a γ ray above 10^{10} ev from the reduction of ionization near the origin of the created pair. The reduction is due to the interference between the electromagnetic field of negatron and that of positron. A method similar to that of Fermi who had treated the energy loss of single electron taking into account the polarizability of the medium was adopted. (auth)

8887

THE SALAM-POLKINGHORNE CLASSIFICATION AND THE NEUTRON CHARGE HYPOTHESIS. Ia. P. Terletskii (Inst. of Nuclear Problems, Academy of Sciences, USSR). Soviet Phys. (Doklady) 1, 303-5(1956) May-June.

The hypothesis of a new conservation law has been advanced to explain the principal characteristics of the production and decay of hyperons and heavy mesons. By an analysis of the Salam−Polkinghorne classification (Nuovo cimento 2, 685(1955)) it is shown that the neutron charge hypothesis (Terletskii, Doklady Akad. Nauk S.S.S.R. 94, 209(1954) and Doklady Akad. Nauk S.S.S.R. 101, 1035 (1955)) is only a different and also the physically simplest formulation of the new conservation law, if the possibility of nonconservation of neutron charge is admitted in slow decay processes. (J.S.R.)

8888

A NEW MODEL IN FIELD THEORY. V. G. Solov'ev (Inst. for Nuclear Problems, Academy of Sciences, USSR). Soviet Phys. (Doklady) 1, 392-5(1956) May-June.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, as abstract No. 805.

8889

NONLINEAR MESON FIELD EQUATIONS. A. A. Borgardt (Dnepropetrovsk State Univ.). Soviet Phys. JETP. 6, 43-9 (1958) Jan.

All possible variants of pseudoscalar mesodynamics with third-order self-action are considered. Asymptotic expressions are obtained for the nonrelativistic potentials of point nucleons. Studies are also made of the solutions of the resulting nonlinear equations that correspond to plane waves, and of the question of the definite character of the energy density. (auth)

8890

QUANTUM KINETIC EQUATION FOR PLASMA WITH ACCOUNT OF CORRELATION. Iu. L. Klimontovich and S. V. Temko (Moscow State Univ.). Soviet Phys. JETP. 6, 102-4(1958) Jan.

A quantum kinetic equation has been obtained for a system of particles with Coulomb interaction. This equation differs from the known quantum kinetic equation by the fact that correlation of the mutual positions of charged particles has been taken into account. (auth)

8891

ON ANNIHILATION OF ANTINUCLEONS. V. M. Maksimenko (P. N. Lebedev Physics Inst., Academy of Sciences, USSR). Soviet Phys. JETP. 6, 180-3(1958) Jan.

The distribution of secondary particles in stars produced in annihilation of nucleon-antinucleon pairs is calculated, using the statistical theory of multiple production of particles. Exact expressions for the statistical weights, taking into account conservation of energy, momentum and isotopic spin, were used in the calculations. The calculations were carried out for several magnitudes of the effective volume in which the energy is distributed, and for several types of particles created in the annihilation. The mean multiplicity (3 to 5) of π mesons obtained theoretically agrees with the available experimental data, whereas the number of K mesons predicted by the theory is substantially higher than experimentally observed. The momentum distribution of secondary π mesons in the center-of-mass system is also computed. (auth)

8892

CORRELATION OF POLARIZED QUANTA IN THE CASE OF NONCONSERVATION OF PARITY. Iu. V. Gaponov and V. S. Popov (Moscow State Univ.). Soviet Phys. JETP. 6, 197-9(1958) Jan.

The angular correlation between the electron and the circularly polarized γ quantum emitted in a cascade β transition is considered in the case when parity is not conserved. The effect of the nuclear coulomb field is neglected. (auth)

8893

THE PROBLEM OF NUCLEON STRUCTURE. B. S. Neganov (Joint Inst. for Nuclear Research). Soviet Phys. JETP. 6, 200-1(1958) Jan.

It is proposed that the fundamental particles of the nucleon are the K meson and the cascade hyperon Ξ and that there exists between the K^{0+} and Ξ^{0-} particles and the corresponding antiparticles $\bar{K}^{0-}$ and $\bar{\Xi}^{0+}$ a strong attractive force which results in the formation of a bound state with a very large mass defect. Wave functions for the consolidated system of K particles and hyperons are formed from which the structure of nucleons is postulated. The structure of the nucleon derived in this manner is $p = K^+ + \Xi^- + K^+ \rightleftharpoons K^+ + (\Xi^0 + K^0)$, $n = K^0 + \Xi^0 + K^0 \rightleftharpoons K^0 + (\Xi^- + K^+)$. The nucleon disintegration is considered on the basis of this structural scheme and some experimental verification is given. It is concluded that the law of conservation of the number of baryons, formulated in

the form of a conservation law for nuclear charge, may be completely invalid. (J.S.R.)

8894

REMARKS ON THE MULTIPLICATIVE RENORMALIZATION GROUP IN THE QUANTUM THEORY OF FIELDS. V. Z. Blank, V. L. Bonch-Bruevich, and D. V. Shirkov (Moscow State Univ.). Soviet Phys. JETP 6, 204-5(1958) Jan.

An examination is made of the renormalization group in quantum electrodynamics and the group relations are obtained without the use of a series expansion, that is, directly from the Schwinger equation for the Green's function. It is shown that the renormalization group actually expresses only the "self-similarity" of the Schwinger equations. (J.S.R.)

8895

GENERALIZATION OF GAUGE INVARIANCE AND COMBINED INVERSION. V. L. Pokrovskii (West-Siberian Branch, Academy of Sciences, USSR). Soviet Phys. JETP. 6, 208-9(1958) Jan.

From a consideration of the wave functions of particles existing in different charge states and the gauge transformations for particles with only one charge state, it is shown that in a theory of particles which are free to assume different charge states invariance is required under generalized gauge transformation and the Lorentz group $x' = Lx$. The problem of assigning the transformation laws for these quantities is then discussed. It is shown that the combined inversion hypothesis, suggested by Landau, is equivalent to the requirement that the theory be invariant with respect to the group of generalized gauge transformations with positive Jacobian. (J.S.R.)

8896

PHASE OF A SCATTERED WAVE. F. S. Los'. Soviet Phys. JETP. 6, 211-12(1958) Jan.

The method of variation of constants is applied to the determination of the phase of the scattered wave in a spherically-symmetric one-particle problem in quantum mechanics. (J.S.R.)

8897

CONSERVATION OF PARITY IN THE THEORY OF ELEMENTARY PARTICLES. V. L. Pokrovskii and Iu. B. Rumer (West-Siberian Branch, Academy of Sciences, USSR). Soviet Phys. JETP. 6, 215-16(1958) Jan.

The system of five-dimensional optics (Usp. Mat. Nauk 8, 6(1953)) gives a natural method for classifying effects in which parity is conserved and is not conserved. Five-dimensional optics is based on the deep-lying symmetry of the equations of classical and quantum mechanics in space, time, and action. The coordinates, time and action, are combined in a five dimensional metric space which is topologically bounded in the action coordinate with a period equal to the Planck constant. The momentum energy and charge are combined in a five-dimensional vector for which a single conservation law is formulated. The action is an algebraic quantity, and a change in the sign of the action is equivalent to ordinary charge conjugation. Two types of effects are considered: emission of a boson by a fermion (pair production) and decay of a boson into two fermions. (J.S.R.)

8898

CONVERGENCE OF THE PERTURBATION-THEORY SERIES FOR A NON-RELATIVISTIC NUCLEON. A. G. Galanin and Iu. N. Lokhov. Soviet Phys. JETP. 6, 221-2 (1958) Jan.

The problem of a non-relativistic nucleon which interacts with a symmetric pseudoscalar meson field does not as yet have an exact analytical solution. However, an analysis of the convergence of the perturbation theory series is made. (J.S.R.)

8899

USE OF THE HARTREE-FOCK EQUATIONS FOR A SYSTEM OF QUASI-PARTICLES. V. M. Eleonskii and P. S. Zyrianov (Ural' Polytechnic Inst.). Soviet Phys. JETP. 6, 225-6(1958) Jan.

By use of the Hartree-Fock equations, an attempt is made to account for the interaction between quasi-particles by means of a self-consistent field. On the assumption that the exchange reactions are accounted for within the framework of the Hartree-Fock equation, the dispersion equation is derived. (J.S.R.)

8900

EXACT BASIS OF THE THEORY OF SPIN WAVES. F. Bopp and E. Werner (Universität Munich). Z. Physik 151, 10-15(1958). (In German)

The hypothesis is proved that in the rigorous multiple electron problem there are equations of the type of the Bloch spin-wave equation when one neglects the spin-orbit and spin-spin interactions. The hypothesis can be applied not only to electrons in solid bodies, but also to atoms and molecules. For direct application to atomic nuclei the fact that the spin interactions in these cases are not negligible is a difficulty. (tr-auth)

8901

APPLICATION OF QUANTUM FIELD THEORY METHODS TO THE MANY BODY PROBLEM. V. M. Galitskii and A. B. Migdal (Moscow Inst. of Industrial Physics). Zhur. Eksptl'. i Teoret. Fiz. 34, 139-50(1958) Jan. (In Russian)

It is shown that the energy and damping of quasiparticles are determined by the poles of a single-particle propagation function. The relation between the two-particle Green's function and the kinetic equation is established. (tr-auth)

8902

ON THE POTENTIAL WELL FOR CHARGED PARTICLES IN A HIGH FREQUENCY ELECTROMAGNETIC FIELD. A. V. Gaponov and M. A. Miller (Gorkii State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 34, 242-3(1958) Jan. (In Russian)

8903

THE CLASSICAL THEORY OF FIELDS. L. Landau and E. Lifshitz. Cambridge, Addison-Wesley Press, Inc., 1951. 361p. $10.00.

A systematic presentation of the theory of electromagnetic and gravitational fields is given, using the special theory of relativity as a basis. The variational principle is used as starting point for the derivation of the basic relations. Problems of electrodynamics of continuous media are not considered, the discussion being limited to microscopic electrodynamics—the electrodynamics of the vacuum and of point charges. The "attempts to construct so-called unified" theories of the electromagnetic and gravitational fields are not considered, since the authors feel that these attempts have led to no positive results. Chapters are included on: the principle of relativity, relativistic mechanics, charges in fields, the field equations, constant fields, electromagnetic waves, the propagation of light, the field of moving charges, radiation of electromagnetic waves, a particle in a gravitational field, and the gravitational field equations. These last two are devoted to a presentation of the theory of gravitational fields, i.e., the general theory of relativity. No previous knowledge of tensor analysis is assumed, but it is worked out along with the development of the theory. (M.H.R.)

Tritium and Tritium Compounds

8904

AVERAGE DECAY ENERGY OF TRITIUM. D. P. Gregory and D. A. Landsman (United Kingdom Atomic Energy Authority, Aldermaston, Berks, Eng.). Phys. Rev. 109, 2091 (1958) Mar. 15.

The heat output of tritium has been determined by calorimetry. If one assumes a half life of 12.26 years, the average beta energy is shown to be 5.57 ± 0.1 kev. This is considerably lower than the value previously reported, and an explanation of this discrepancy is offered. (auth)

Uranium and Uranium Compounds

8905 CF-58-4-25

Oak Ridge National Lab., Tenn.

TABLE OF CURRENT VALUES FOR THE DISTRIBUTION OF ENERGY RELEASED BY THE FISSION OF U^{235} INDUCED BY THERMAL NEUTRONS. [PART] II. F. C. Maienschein. Apr. 7, 1958. 3p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

8906

PROBLEMS OF THE UTILISATION OF POLISH URANIUM-BEARING RAW MATERIALS. T. Adamski (Inst. of Nuclear Research, Warsaw). Nukleonika 3, 15-25(1958). (In Polish)

The economic importance of uranium as the basic material for electrical power production is discussed. The economic aspects and the problems in utilization of uranium ore deposits are analyzed. (R.V.J.)

8907

LOW-TEMPERATURE MAGNETIC STUDIES OF URANIUM HYDRIDE, URANIUM DEUTERIDE, AND URANIUM DIOXIDE. Warren E. Henry (U. S. Naval Research Lab., Washington). Phys. Rev. 109, 1976-80(1958) Mar. 15.

A study of magnetization as a function of temperature and magnetic field has been carried out for uranium hydride, uranium deuteride, and uranium dioxide at temperatures from 300°K to 1.3°K and in magnetic fields from 60,000 gauss down to zero field. The apparent saturation magnetization for the samples of beta-uranium hydride used is 1.18 ± 0.03 Bohr magnetons per atom of uranium and for one sample of uranium deuteride is 0.98 ± 0.03 Bohr magneton per atom of uranium. The magnetic moment of uranium dioxide, limited by what may be antiferromagnetic ordering, is about 0.025 Bohr magneton per atom of uranium at 35,000 gauss and 1.3°K. This result makes possible corrections for the moments of UH_3 and UD_3 on the basis of a known oxygen content or an estimate of the oxide impurity on the basis of apparent saturation. A high zero-field remanent magnetization (over 50% of the saturation magnetization for a spherical sample) is observed, attesting to the pronounced magnetic hardness of beta-uranium hydride. Analytic expressions have been worked out for magnetization as a function of temperature for zero magnetic field and 11,500 gauss, leading to a paramagnetic θ of 180°K and a ferromagnetic θ of 168°K. An estimate of 2×10^6 gauss is made for the molecular field in UO_2. (auth)

8908

INELASTIC NEUTRON SCATTERING BY U^{238}. L. Cranberg and J. S. Levin (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 109, 2063-70(1958) Mar. 15.

Monoenergetic neutrons in the range 0.5 to 2 Mev have been scattered from U^{238} and the spectra of scattered neutrons have been investigated by a time-of-flight method. Levels have been located at 0.044 ± 0.004, 0.146 ± 0.006, 0.30 ± 0.03, 0.73 ± 0.02, 0.98 ± 0.02, 1.06 ± 0.03, and 1.26 ± 0.04 Mev. The cross sections for excitations of these levels have been obtained corresponding to inelastic neutron scattering at 90°. An angular distribution has been obtained for the inelastically scattered neutrons corresponding to excitation of the 44-kev level by incident neutrons of 550-kev energy. This distribution is of the form $A(1-B\cos^2\theta)$ where A is 0.135 ± 0.02 barn per steradian and B is 0.45 ± 0.1. The cross section is in good agreement with calculations by Chase and Wilets which indicate compound nucleus formation is the dominant mechanism in inelastic neutron scattering by U^{238} at 550 kev, although the anisotropy is larger than that predicted. (auth)

8909

ANGULAR DISTRIBUTIONS OF PHOTOFISSION FRAGMENTS FROM URANIUM. B. P. Bannik, N. M. Kulikova, L. E. Lazareva, and V. A. Iakovlev (P. N. Lebedev Physics Inst., Academy of Sciences, USSR). Soviet Phys. JETP. 6, 39-40(1958) Jan.

The angular distributions of photofission fragments from uranium at x-ray energies of 9.4, 12, and 26.5 Mev were determined using a 30 Mev synchrotron. The anisotropy was found to increase sharply with decreasing x-ray energy. The ratios of the anisotropic to the isotropic fission yields at the above energies were 0.55 ± 0.09, 0.13 ± 0.05, and 0.05 ± 0.04 respectively. (auth)

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